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January 6, 2005

Ms. Sabrina Forrest  
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**SUBJECT: START2, EPA Region VIII, Contract No. 68-W-00-118, TDD No. 0405-0006  
Site Reassessment - Analytical Results Report,  
Valmont Butte / Allied Piles, Boulder County, Colorado**

Dear Sabrina:

Attached is the final Analytical Results Report for Site Reassessment for the Valmont Butte / Allied Piles site in Boulder County, Colorado. This document has been revised in accordance with comments that were received. Below is a summary of the revisions that were made.

- A screening level risk evaluation conducted by an EPA toxicologist has been added as Appendix H.
- Data have been added to wet chemistry tables; trilinear diagrams and discussion have been added to Appendix F.
- The key to sample IDs has been moved to the beginning of the text.
- A discussion of background arsenic levels in Colorado and Boulder Creek has been added.
- The threatened and endangered species list has been updated.
- The surface soil around and under the sweat lodge has been sampled, analytical results have been added to Table 4, and discussion has been added to the text.
- XCEL fly ash analytical results have been included in Table 25 and text has been added in Section 6.2.
- Various clarifications and edits have been made to text, tables, and figures.

This document is submitted for your approval. If you have any questions, please call me at 303-291-8202.

Very truly yours,

URS OPERATING SERVICES, INC.



Bev Halwa  
Project Manager

cc: T. F. Staible/UOS w/o attachments  
File/UOS

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# START2

Superfund Technical Assessment and Response Team 2 -  
Region VIII

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**United States  
Environmental Protection Agency**

**Contract No. 68-W-00-118**

**ANALYTICAL RESULTS REPORT  
for SITE REASSESSMENT**

**VALMONT BUTTE / ALLIED PILES  
Boulder County, Colorado**

**TDD No. 0405-0006**

**JANUARY 6, 2005**



**URS**  
**OPERATING SERVICES, INC.**

In association with: Tetra Tech EM, Inc.  
URS Corporation  
LT Environmental, Inc.  
TN & Associates, Inc.  
TechLaw, Inc.

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**ANALYTICAL RESULTS REPORT  
for SITE REASSESSMENT**

**VALMONT BUTTE / ALLIED PILES  
Boulder County, Colorado**


**CERCLIS ID# COD078348737**

**EPA Contract No. 68-W-00-118  
TDD No. 0405-0006**

**Prepared By:  
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6 Jan 05

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1/6/05

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**ANALYTICAL RESULTS REPORT for  
SITE REASSESSMENT**

**VALMONT BUTTE / ALLIED PILES  
Boulder County, Colorado**

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### Key To Sample IDs

xx-yy-zz-##	Code	Description
xx	VB	Valmont Butte
yy	BP	Bore - Primary Tailings Pond
	BS	Bore - Secondary Tailings Pond
	BD	Bore - Disposal Pit
	DW	Groundwater - Domestic Well
	DP	Bore - Primary Tailings Pond Dike Dam
	GW	Groundwater - Geoprobe® Well
	NA	Surface Soil from location of sweat lodge
	PR	Source - Product
	SE	Sediment
	SG	Soil Gas and Surface Soil Sample Location
	SL	Surface Soil (0 - 24 inches bgs, as noted)
	SO	Surface Soil (0 - 24 inches bgs, as noted)
	SU	Surface Soil (0 - 24 inches bgs, as noted)
	SW	Surface Water
	TW	Groundwater - Terracon Monitoring Well
zz	##	Bore identifier or sequential sample number
	RS	Radiological Sample - Shallow (0 - 15 cm bgs)
	RD	Radiological Sample - Deeper (15 - 30 cm bgs)
	M0 or MO	Inorganic Soil Sample - (0 - 1 inch bgs)
	MS	Inorganic Soil Surface - (1 - 18 inches bgs)
	MD	Inorganic Soil Sample - (24 inches bgs to native soil)
##	##	Starting depth interval
D	D	Duplicate sample

## **1.0     INTRODUCTION**

This Analytical Results Report (ARR) for the Site Reassessment (SR) of the Valmont Butte / Allied Piles site (CERCLIS ID# COD078348737) in Boulder County, Colorado, has been prepared to satisfy the requirements of Technical Direction Document (TDD) No. 0405-0006 issued to URS Operating Services, Inc. (UOS) under the U.S. Environmental Protection Agency (EPA) Region VIII Superfund Technical Assessment and Response Team 2 (START2) Contract No. 68-W-00-118. This report has been prepared in accordance with the EPA "Guidance for Performing Site Inspections Under CERCLA," Interim Final, September 1992, and the "Region VIII Supplement to Guidance for Performing Site Inspections Under CERCLA" (U.S. Environmental Protection Agency (EPA) 1992; EPA 1993). Field work at the Valmont Butte / Allied Piles site was conducted August 25 through September 2, on October 29, and on December 12, 2004, by UOS and the EPA and followed the Field Sampling Plan (FSP) approved by the EPA Site Assessment Manager (SAM) Sabrina Forrest on August 16, 2004, the Site Inspection (SI) format, the applicable UOS Technical Standard Operating Procedures (TSOPs) and the Generic Quality Assurance Project Plan (QAPP) (URS Operating Services, Inc. (UOS) 2004e; UOS 2004a; UOS 2004b).

This SR resulted in the collection of 305 field samples for on-site or off-site laboratory analysis, not including the samples that were collected for the classification of the hazardous contents of tanks, drums, and transformers. Samples that were collected for off-site laboratory analysis included 1 polychlorinated biphenyl (PCB) product sample, 29 water samples, 66 soil samples, and 30 soil gas samples. A total of 179 soil samples were collected for on-site X-Ray Fluorescence (XRF) analysis; and 15 samples were collected for quality assurance/quality control (QA/QC).

Soil and water samples were shipped by Federal Express on August 25, August 27, September 3, and September 9, 2004, to EPA Contract Laboratory Program (CLP) laboratory, Ceimic Corporation in Narragansett, Rhode Island, for analysis for total target analyte list (TAL) metals, dissolved TAL metals, and/or semivolatile organic compounds. Soil and water samples were hand delivered on August 25, August 27, September 2, September 3, and September 9, 2004, to Severn Trent Laboratories in Arvada, Colorado, for radiological, wet chemistry, Synthetic Precipitation Leaching Procedure (SPLP), and/or PCB analyses. Gas canisters were shipped by Federal Express on September 1, 2004, to ERG in Albuquerque New Mexico, for radon gas analysis.

This ARR is intended to be used in conjunction with the Valmont Butte / Allied Piles FSP (UOS 2004e) and the Valmont Butte / Allied Piles Sampling Activities Report (SAR) (UOS 2004f) (Appendix A).

## **2.0 OBJECTIVES**

The purpose of this SR was to gather information for the evaluation of the current site conditions with regard to the EPA's Hazard Ranking System (HRS) and removal criteria (Office of the Federal Register 1990). In addition, the EPA Region 3 Risk Based Concentrations (RBCs), EPA Lead Sites Workgroup industrial benchmark, and EPA residential soil benchmark for human health risk evaluation have been used to evaluate the site with regard to its planned use (EPA 2004a; EPA 2004g; EPA 2003). The specific objectives of this SR were to:

- Review previous work performed at the site;
- Identify, confirm, and characterize sources at the site according to the HRS and removal criteria;
- Evaluate the groundwater, surface water, soil exposure, and air pathways;
- Identify target populations;
- Determine if elevated concentrations of contaminants suggest that further investigation may be necessary;
- Determine if a threat to human health or the environment exists now or will result from the planned use; and
- Ensure that the investigation is conducted without impact to cultural remains and artifacts.

## **3.0 BACKGROUND INFORMATION**

### **3.1 SITE LOCATION AND DESCRIPTION**

The site is located at 3000 North 63<sup>rd</sup> Street, approximately four miles east of the Boulder central business district (Figure 1). Access to the site is from 63<sup>rd</sup> Street at the southwest corner or through a locked gate on Valmont Road at the east end of the site. Directions to the site from Boulder are to drive north on State Road 157 (Foothills Parkway), right on Pearl Street, straight onto Pearl

Parkway, straight onto Valmont Road, straight past 61<sup>st</sup> Avenue on the left for 0.8 mile, and right onto a dirt road with a locked gate at the east end of the property. The 102-acre site is located in the south half of the southeast quarter of Section 22, T. 1 N., R. 70 W. and extends into the southwest quarter of Section 23. The geographic coordinates of the site are approximately 40° 01' 50" north latitude and 105° 12' 12" west longitude (U.S. Geological Survey (USGS) 1979; U.S. Department of Commerce, Bureau of the Census (USDOC) 2000).

The mill operations area covers approximately eight acres on the western end of the site (Photo 2 in Appendix B). The tailings ponds area, which has been covered with soil, includes approximately seventeen acres in the center of the site (Figure 2). Site structures are related to milling activities and include the original milling building, an office building, the assay office, a wash room, the pump house, a converted garage, and other small buildings housing support operations. A strip of land measuring 330 feet wide from the center line on Valmont Road is zoned agricultural, runs the entire length of the property, and includes the Valmont dike (Photos 1 and 20 in Appendix B). The two entrance roads are gated and locked. The site is partially fenced but is accessible on foot. Recreational attractions to the site include the Valmont Butte and the mill buildings; evidence of trespassing includes broken locks on mill building doors (Figure 2) (Valmont Butte Corporation (undated); UOS 2004c).

Residential homes and an asphalt plant are located north of the site. Approximately 20 water-filled gravel pits are in this area including City of Boulder Open Space Mountain Parks Sawhill Ponds and the Boulder County Walden Ponds Wildlife Habitat. Small farms growing alfalfa, hay, and produce are located north and east of the site. To the south and east is Xcel Energy property including vacant land, the Culbertson Mill site (CERCLIS ID # CO0001910991), and three reservoirs (Leggett, Hillcrest, and Valmont) used for cooling at the Xcel power plant to the southeast. The Leggett Reservoir has been leased by the state of Colorado as a wildlife refuge since the mid 1930s. A fill area containing fly ash from the power plant operations is also located adjacent to the property to the east. Also to the south, the three-acre Valmont Cemetery, owned by the Valmont School District #4 Cemetery Association, is a rectangular parcel bordering the site on three sides. The La Farge Recycle facility is located on the southwest side of the butte and immediately west of the site. The Stazio Ball Fields and the Western Disposal transfer facility, a hazardous waste recycling facility, and offices are located to the west across 63<sup>rd</sup> street (UOS 2000; Valmont Butte Corporation (undated)).

### **3.2 SITE HISTORY AND PREVIOUS WORK**

Prior to 1881 when the last of the remaining native tribes were removed from the area, the region around and including the site was used by the members of the Arapahoe and Ute Tribes as campgrounds, hunting areas, and burial sites. Historical accounts describe an antelope roundup held in the vicinity of Valmont dike in 1860 and the use of land around Valmont Butte and east of the cemetery for a winter campground. There are anecdotal accounts of Native American burials in the study area; locations are unknown. Artifacts collected from the site in 1959 and curated at the CU Museum are typical of artifacts from a Native American camp or habitation site. The Valmont Butte continues to be used by Native Americans, under a permit with the city of Boulder, for cultural purposes including sweat lodge ceremonies (RMC Consultants, Inc. (RMC) 2001; Burney, Michael S. (Burney) 2004; Carol Affleck, et al (Affleck) 2004a).

Land south of the dike was deeded as a cemetery in 1873 and 1912 (Burney 2004). A local historian stated that the entire cemetery is not enclosed within the fenced area; additional unmarked graves exist outside the fenced area (Figure 2) (Teegarden 2003). The site was open land used for grazing prior to the start of milling activities (Keeter 2004a). The St. Joe's Mineral Corporation acquired the site in 1936 and began construction of a gold mill (Alisto Engineering Group 2000). This mill, perched on the side of the Valmont dike was an ideal location for a gravitational flotation mill (Photo 2). The ore concentrator drew water up the hill for use in the process. The mill was reconfigured to concentrate fluorspar and was owned and operated from the 1940s until the 1970s by Allied Chemical to recover fluorspar from Burlington Mine ore from the Jamestown area in western Boulder County (Alisto Engineering Group 2000; Hendricks Milling Company 1984; Valmont Butte Corporation (undated)).

The milling process consisted of crushing the rock to a very fine powder to liberate the metals. The crushed material was then mixed within a water solution with a non-petroleum-based oil to separate the mineral from the waste rock. The oil attached itself to the metals, which then floated to the top of the flotation cells. This material was collected in tanks and dried prior to shipment. The pH of the waste or tailings material was neutralized and then pumped to the tailings ponds. The tailings from Burlington mine are known to contain naturally occurring radioactive materials (NORMs). Fluorspar ore may also contain uranium, radium, thorium, and their respective daughter products, as well as lead, vanadium, chromium, arsenic, copper, zinc, selenium, and molybdenum. Reportedly

only a few chemicals were used on site, most related to the maintenance of the mill equipment such as lubrication oils, diesel fuel, lime, soda ash, and paint (Alisto Engineering Group 2000; Valmont Butte Corporation (undated)).

The mill and property were sold to Tusco in 1976. Hendricks Milling Company, owned by Power Petroleum, Inc., leased the property from Tusco and reconfigured the mill to extract gold from ore from the Caribou Mine west of Nederland, Colorado (Hendricks Milling Company 1984). Milling operations ceased in 1985. In 1994, the Valmont Butte Corporation acquired the site as an investment and several small tenants resided and/or operated businesses such as log home building at the property until it was sold to the city of Boulder in 2000 (Alisto Engineering Group 2000; Valmont Butte Corporation (undated)).

Boulder County has designated Valmont Butte a natural landmark in the Boulder County Comprehensive Plan (Valmont Butte Corporation (undated); Boulder County 1995). Natural Landmarks are defined by Boulder County as prominent landscape features that distinguish a specific locality in Boulder County and are important because of views they afford, their value as scenic vistas and backdrops, and the intrinsic value they hold as wildlife and plant habitats, natural areas, park and open space preserves, and open lands (Boulder County 1995). The butte is also an archaeological site where Native American artifacts have been recovered. Artifacts from the south side of the butte were recorded and collected in 1959 (RMC 2001; Burney 2004).

The city of Boulder is considering annexation of and three distinct uses for the site. The city of Boulder conceptual site layout was included as Appendix A of the FSP. The Public Works Department is proposing to construct a Biosolids Recycling Center on 38.3 acres at the eastern end of the property. The Fire Department is proposing to construct a Fire Training Center on 36.4 acres at the center portion of the site. The remaining 26.9 acres is managed by the City of Boulder Open Space Mountain Parks and includes the Valmont dike along the north boundary of the property. The Valmont Mill represents a small 50- to 200-tons-per-day ore processing facility that is virtually intact for illustrating flotation milling. The Valmont Mill has been evaluated as being eligible for the National Register of Historic Places with the main mill building and adjacent water system pump house retaining integrity (RMC 2001). The development plans for the Biosolids Recycling Center and Fire Training Center portions show that 79.1 acres or 78.5 percent of the site would be comprised of either undeveloped open space or landscaped area. Under the proposal, limitations on

public access to the site will be established (Community and Environmental Assessment Process (CEAP) 2004; Native Cultural Services 2004).

Documentation in the files of the EPA, Colorado Department of Public Health and Environment (CDPHE), and Boulder County indicates that the site has been a focus of concern because of potential releases from the site to groundwater, surface water, soil exposure, and air pathways since the 1960s. A summary of previous work and available data, sometimes inconsistent, was included in the FSP (UOS 2004e).

### **3.3 SITE CHARACTERISTICS**

#### **3.3.1 Physical Geography**

The elevation of the 102-acre site ranges from approximately 5,391 feet above mean sea level (amsl) on the summit of the butte at the northwest corner down to approx 5,170 feet amsl in the basin of the north-central portion of the site (Alisto Engineering Group 2000; USGS 1979). The topographic plateau that crosses the western portion of the site, coupled with the dike along the northern site boundary, forms a small basin where the tailings were deposited behind man-made earthen dams. The basin topography prevents off-site drainage into the site (Figure 4) (Alisto Engineering Group 2000; CEAP 2004).

The mill site covers about 8 acres and is located along the southern flank of the highest portion of the site. East of the mill buildings are the dry primary tailings pond (approximately 12.5 acres) and the secondary tailings pond (approximately 4.5 acres). The vegetation is predominantly weedy grasslands and tree thicket dominated by small-diameter Russian olive and plains cottonwoods (CEAP 2004). An earthen dam (the primary tailings pond dam), approximately 30 feet high, contains the tailings at the east end of the primary tailings pond. A second dam (the secondary tailings pond dam), approximately 20 feet high, is located about 1,000 feet east of the primary dam and contains the secondary tailings pond. The dike, including three dams located in fractured areas of the dike, forms the north flank of the tailings ponds (Figure 2) (Colorado Department of Public Health and Environment (CDPHE) 1996; UOS 2004e).

Extensive human use of the area in the past has compromised the vegetation and habitat and much of the site is weedy; however, the north-facing, shrub-covered slope overlooking Valmont Road may contain some relatively undisturbed habitat. A shrub ecosystem occurs on the north-facing hillside of the Valmont dike. The flatter areas on the north side of Valmont dike consist primarily of weedy grasslands that are a result of past land uses and reclamation activities. The south side of the site contains a disturbed upland area dominated by forbs (CEAP 2004).

### **3.3.2 Geology and Hydrogeology**

An east-west trending volcanic dike about 60 feet wide runs along the north side of the site. The dike rises approximately 200 feet above the surrounding plains and is three miles in length. The bedrock in the area is Pierre Shale that underlies most of the site and outcrops against the side of the dike. The intrusion of the dike into the Pierre Shale caused a halo of metamorphosis in the host shale and probably locally deformed the shale into a dome shape (Runnels 1976; Native Cultural Services 2004; U.S. Department of Agriculture 1975). Columnar jointing in the dike is visible on the site in the locations of the three man-made dike dams (Figure 2). Any potential contaminate plume moving north would be slow moving from the source point and would likely be influenced by permeability channels and surficial weathering (University of Colorado 1973).

The possibility of contaminated waters leaving the primary tailings area is very low for several reasons. Bedrock identified in seven on-site bores from Ecology and Environment, Inc. (E&E) and Terracon investigations suggest that a bedrock trough under the tailings ponds dips to the east (Ecology and Environment, Inc. (E&E) 1985; Terracon 2003). However, as documented in the bore logs included in Appendix C, the soil that comprises the primary tailings is a mixture of very fine-grained sand, silt, and clay, with silt and clay dominating. The permeability and porosity of silt and clay soils is very low; therefore, the mobility of water through the site is very low. The underlying native rock, identified as the Pierre Shale, is described in this report and in the bore logs (Appendix C) as a siltstone and was dry in each boring that encountered the siltstone. There is evidence in the bores that water is contained within the area, with the mounding of groundwater in the center of the primary tailings area. If water were leaving the area

there would be a downward gradient toward the area where the water is leaving the site. No definitive statement can be made about the hydrogeology in the secondary tailings area. The lack of saturated soils in the area does not eliminate the possibility that groundwater is flowing through and leaving this area. The fact that coarse sand and gravel that could act as channels were encountered in the borings adds to this uncertainty (Appendix C).

Residences north of the site are not served by a public drinking water system and many use shallow alluvial domestic wells less than 40 feet below ground surface (bgs) for drinking water (UOS 2004c).

### **3.3.3 Hydrology**

Surface water from the western portion of the property where the mill is located drains to a ditch along 63<sup>rd</sup> Street and Valmont Road. This stormwater drainage ditch flows under the Jones Donnelly Ditch into South Boulder Creek at the outlet of the KOA lake. South Boulder Creek, with an average flow rate of 30 cubic feet per second (cfs), flows to the north where it enters Boulder Creek. Boulder Creek has an average flow rate of 111 cfs (Figure 4) (USGS 1997b).

Surface water from the small area west of the cemetery drains to the south to Xcel property. Surface water from the remainder of the site south of the dike flows to the east. Water flowing on or into each of the tailings ponds pools on the pond until it infiltrates or more likely evaporates.

Surface water east of both tailings ponds flows into the wetlands area at the east boundary of the site, into a ditch on the south side of Valmont Road, through a culvert under Valmont Road and under Butte Mill Ditch, and into the Keeter Pond (Figure 4).

Surface water draining from the north slope of the dike flows into the ditch on the south side of Valmont Road, and depending on flow direction, through one of two culverts under Valmont Road and under Butte Mill Ditch and into either the Ready-Mix pond or

the Keeter pond on the north side of Valmont Road. The ponds are in contact with the alluvial aquifer (Figure 4).

The closest surface water body is Butte Mill Ditch, which flows through the residential properties on the north side of Valmont Road and is used for irrigation east of the site. A culvert empties into the ditch that drains the area around two silos that are located at 6379 Valmont Road (UOS 2004d). Downgradient farmers are concerned about potential impacts such as might occur during high precipitation conditions. The Butte Mill Ditch has an average flow rate of five cfs (Boulder County Water Commission 1998). The site is located outside the 100-year and 500-year floodplains (Federal Emergency Management Agency (FEMA) 1995).

#### **3.3.4 Meteorology**

The site is located in a semiarid climate zone. The mean annual precipitation as totaled from the University of Delaware (UD) database is 15 inches. The net annual precipitation as calculated from precipitation and evapotranspiration data obtained from the UD database is 2.6 inches (University of Delaware, Center for Climate Research, Department of Geology 1986). The 2-year, 24-hour rainfall event for this area is 1.5 inches (Dunne, Thomas and Luna B. Leopold 1978; UOS 2000). Wind rose data from the Boulder Municipal Airport indicate average annual wind speed is 8.5 to 11 miles per hour (mph) with the predominant wind direction from the south and south-southwest at least 20 percent of the time. Valmont Butte and Valmont Reservoir may influence local wind patterns. Monthly wind rose data were included in Appendix D of the FSP (UOS 2004e).

### **4.0 SOURCES (WASTE CHARACTERISTICS)**

The major sources of contamination on the site are the tailings located in the primary and secondary tailings ponds; radium-contaminated construction debris buried in a disposal pit; and drums, tanks, and transformers remaining on site from previous operations. In addition to radioactivity from fluorspar tailings, lead and arsenic have been identified as contaminants of concern in the tailings. Sample

locations for the 6 drum samples, 54 surface soil samples, 21 core samples, and 30 radon gas and surface soil samples are shown in Figure 3.

#### **4.1 SOURCE AND SOIL SAMPLING**

Analytical results for source and soil samples are in Tables 1 through 5. Analytical results are compared to EPA Superfund Chemical Data Matrix (SCDM) benchmarks for HRS purposes and Region III RBCs, Lead Sites Workgroup benchmark, and EPA residential soil benchmarks for risk screening purposes; benchmarks are included in the tables (EPA 2004d; EPA 2003; EPA 2004a). The radiological samples were collected from the 0 to 15 centimeters (cm) and 15 cm to 30 cm intervals so the results could be compared to EPA remediation goals for those intervals (EPA 1998). Surface soil samples were collected from 0 to 1 inch bgs for use in a human health risk screening. Surface soil samples were collected from intervals between 0 and 24 inches for use in HRS evaluation where surface soil is defined as 0 to 24 inches bgs. HRS defines subsurface soil as being more than 24 inches bgs (EPA 1992).

Composite surface soil samples were prepared from the cores collected from the primary tailings pond, the secondary tailings pond, the disposal pit, and the primary pond dike dam. From each tailings pond and the pit, a composite surface soil sample was collected from the cores from the 0 to 15 cm bgs interval for radiological analysis (samples VB-BP-RS, VB-BS-RS, and VB-BD-RS). From each tailings pond and the pit, a composite soil sample was collected from the cores from the 15 to 30 cm bgs interval for radiological analysis (samples VB-BP-RD, VB-BS-RD, and VB-BD-RD). From each tailings pond and the pit, surface soil samples were collected from the cores from the 0 to 1 inch bgs interval and composited and three samples were prepared from each source area for XRF analysis (sample ID prefixes VB-BP-MO, VB-BS-MO, and VB-BD-MO). One sample was collected for XRF analysis from 0 to 1 inch bgs in the primary dike dam core (sample VB-DP-MO-01). From each tailings pond, the pit, and the primary pond dike dam, surface soil samples were collected from 1 inch to 18 inches bgs and composited and three samples were prepared from each source area for XRF analysis (sample ID prefixes VB-BP-MS, VB-BS-MS, VB-BD-MS, and VB-DP-MS). In addition surface soil was collected from 0 to 1 inch bgs at other surface locations in those areas and identified with the prefixes VB-SG, Delta, and HMS.

Subsurface soil samples were collected from cores in the primary and secondary tailings ponds, the primary tailings pond dike dam, and the disposal pit. The prefix for samples collected in the primary tailings pond are VB-BP- and the next two digits identify the bore locations 02, 05, 07, 14, 16, 17, 20, and 30. The prefix for the secondary tailings pond is VB-BS- and the next two digits identify the bore locations 32, 33, 34, 36, 38, and 39. The prefix for the disposal pit is VB-BD- and the next two digits identify the bore locations 01, 02, 03, 04, 05, and 06. Bore 03 was determined to be outside the disposal pit since no construction debris was observed. The prefix for the single bore collected in the primary dike dam is VB-DP-01. The fourth segment of the sample identifier is the depth below which the sample was collected. For example, sample VB-BP-02-27 was collected from the bore 02 in the primary tailings pond from a depth starting at 27 feet bgs. In addition, from each tailings pond, the disposal pit, and the primary pond dike dam, subsurface soil was collected at 1-foot intervals from 2 feet bgs to native soil and composited and three samples were prepared from each source for XRF analysis (samples VB-BP-MD, VB-BS-MD, VB-BD-MD, and VB-DP-MD) and for SPLP analysis (samples VB-BP-MD, VB-BS-MD, VB-BD-MD, and VB-DP-01).

Soil samples were collected from other areas on site including drum contents for XRF or SVOC analysis (Sample ID prefixes VB-SL, VB-SG, VB-SU, and VB-SO). The depth increment for each specific sample and the location description is in Tables 1 and 4.

## **4.2 PRIMARY TAILINGS POND**

The primary tailings pond dam to the east and the igneous dike and dike dam to the north defines the primary tailings area (Figure 3). The soil cover in the eight cores collected in the primary tailings pond varies in thickness from 10 inches to 24 inches with an average thickness of 17 inches (Table 1 in Appendix A; Appendix C). The tailings consist of two deposits. The first or upper deposit is the gold tailings, which are characterized by a light yellow gray to an orange color. The gold tailings are silts with an occasional sand component and vary between 0.9 foot and 5.5 feet in thickness. The underlying fluorspar tailings are characterized by inter-bedded light gray silty sand and dark gray-black clay. The fluorspar tailings vary between 14 feet and 39 feet in thickness. The tailings are 20 feet to 30 feet in depth at the boundaries and more than 40 feet in the center of the tailings area. The groundwater levels encountered in the primary tailings area range from 10 feet bgs to 33 feet bgs. The more shallow groundwater levels occur in the

middle of the area. The single borehole drilled in the dike dam indicates that processed tailings were used to create the dam.

There appears to be no fill cover in some small areas, such as surface (zero to one inch bgs) soil sample location HMS04, where a sample was collected by UOS during the July 15, 2004, site reconnaissance (UOS 2004g). Lead was detected in that sample by XRF analysis at a concentration of 3,400 parts per million (ppm) (Table 1). In addition, prairie dogs have burrowed into the primary tailings pond and brought tailings to the surface (Photos 6 and 21 in Appendix B show prairie dog mounds). Lead concentrations detected by XRF analysis ranged from 610 ppm to 2,400 ppm in five soil samples collected from the mounds of prairie dog burrows at sample locations HMS01, HMS03, HMS05, HMS06, HMS07, and HMS08 (Table 1) (Figure 3) (UOS 2004f). Lead concentrations detected by XRF analysis ranged from 2,300 ppm to 3,300 ppm in three soil samples collected from prairie dog mounds at sample locations Delta-3, Delta-4, and Delta-5 where the radiation readings were higher than background. Lead concentrations detected by XRF analysis in fourteen composite surface soil samples collected from zero to one inch bgs in the same locations as the radon flux canisters were placed (Photo 19 in Appendix B) ranged from 36 J to 1,300 ppm and averaged 167 ppm (Table 1). The average lead concentration detected in the composite surface soil samples collected from zero to one inch bgs from the eight cores was 99 ppm. The average lead concentration detected in the composite surface soil sample collected from the cores from the one- to eighteen-inch bgs interval was 238 ppm (Table 1).

Forty-three subsurface (more than two feet bgs) soil grab samples were collected from cores. Lead concentrations detected by XRF analysis ranged from 28 ppm (native soil beneath the tailings) to 14,000 ppm with an average lead concentration of 2,331 ppm. The average lead concentration detected in the composite subsurface soil samples collected from the primary tailings pond cores was 2,600 ppm. Uranium levels were detected by XRF analysis as high as 230 ppm, arsenic as high as 150 ppm, and mercury as high as 61 ppm (Table 1).

One bore was advanced in the primary tailings pond dike dam. Four grab samples were collected for XRF analysis; the lead concentrations in the grab samples were as high as 10,000 ppm with an average of 4,707 ppm and arsenic was detected as high as 200 ppm. The average lead

concentration detected in the three composite subsurface soil samples collected from the primary tailings pond dike dam core is 2,900 ppm (Table 1).

The radiological concentrations in samples collected from the core that was collected from the primary tailings pond dike dam were higher than any levels detected in the tailings pond (Table 2). In the primary tailings pond dike dam, field radiological readings ranged from 0.27 to 0.90 milliRoentgens per hour (mR/hr). In the primary tailings pond cores, readings ranged from 0.016 to 0.081 mR/hr (Appendix C). The background reading for the site was 0.019 mR/hr (UOS 2004d). Composite surface soil sample VB-BP-RS was collected from the zero to fifteen cm bgs interval and composite surface soil sample VB-BP-RD was collected from the fifteen to thirty cm bgs interval from the cores in the primary tailings pond for radiological analysis. No remediation goals have been established for radiation levels in industrial soil; the soil cover sample results for radiation are in Table 2 and are below EPA remediation goals for residential soil.

A subsurface source sample (two feet bgs to native soil) was collected at one-foot intervals from all the cores, composited, and submitted to the laboratory for SPLP analysis. The results are in Table 3 and all inorganic concentrations were below the Toxicity Characteristic Leaching Procedure (TCLP) benchmarks indicating that the probability of metals leaching out of the tailings is not significant. Although there are no benchmarks for leaching of radioactive substances, since the results of the SPLP analysis are higher in the primary tailings pond dike dam than in either tailings pond, the potential for leaching of gross alpha and gross beta emitting elements may be higher in the primary pond dike dam than in the tailings ponds or the disposal pit. However, there is no evidence of leaching in drinking water wells sampled north of the site. While the levels of subsurface radiation detected during this site reassessment were low, the involvement of a health physicist for future intrusion into the tailings would be advisable to monitor radiation levels to ensure worker protection from excessive radiation exposure.

The volume of fluorspar and the volume of gold tailings was estimated by UOS based on geologic inference, bore logs, and professional judgement. The volume of fluorspar tailings is estimated to be 327,000 cubic yards and the volume of gold tailings is estimated to be 45,000 cubic yards. Bore logs are in Appendix C.

#### **4.3 SECONDARY TAILINGS POND**

The secondary tailings pond dam to the east and the igneous dike to the north define the secondary tailings area (Figure 3). The soil cover in the six cores collected in the secondary tailings pond ranged from 16 inches to 36 inches with an average thickness of 23.5 inches (Table 1 in Appendix A; Appendix C). The tailings deposited in this area are the fluorspar mill tailings, based on the color and consistency similarities to the fluorspar tailings in the primary tailings pond. The upper tailings are sands and silts. The lower tailings are much more coarse grained than those in the primary tailings area.

Prairie dogs have also burrowed into the secondary tailings pond. Lead concentrations detected by XRF analysis in six composite surface soil samples collected from the same locations as the radon flux canisters were placed, zero to one inch bgs, ranged from 39 J to 340 ppm and averaged 181 ppm. The average lead concentration detected in the composite surface soil samples collected from the zero to one inch bgs interval from the six cores was 332 ppm. The average lead concentration detected in the composite surface soil sample collected from the six cores at the one inch to eighteen inch bgs interval was 417 ppm (Table 1).

Nine grab samples were collected from the six cores. Excluding one outlying sample result, the highest lead level detected was 34 ppm with an average lead concentration of 21 ppm. The average lead concentration detected in the composite subsurface soil samples collected from the secondary tailings pond cores is 183 ppm. Uranium, arsenic, and mercury were not detected above detection limits (Table 1).

In the secondary tailings pond cores, radiation readings ranged from 0.018 to 0.053 mR/hr. Composite surface soil sample VB-BS-RS was collected from the zero to fifteen cm bgs interval and composite surface soil sample VB-BS-RD was collected from the fifteen to thirty cm bgs interval from the cores in the secondary tailings pond for radiological analysis. There are no remediation goals for radiation in industrial soil; however, analytical results were below the EPA remediation goals for residential soil (Table 2).

The results of the subsurface composite source sample collected and submitted for SPLP analysis are in Table 3 and all inorganic concentrations were below the TCLP benchmarks indicating that the probability of metals leaching out of the tailings is not significant.

The volume of fluorspar tailings was estimated based on geologic inference, bore logs, and professional judgement. The volume of fluorspar tailings in the secondary tailings pond is estimated to be 70,000 cubic yards. Bore logs are in Appendix C.

#### 4.4 DISPOSAL PIT

Six bores were advanced to locate the disposal pit; five of the bores were within the disposal pit as determined by the direct observation of construction debris (Photo 4 in Appendix B) (Figure 3). The GPS data points are listed in the table below so that the disposal pit can be located in the future should the need arise. The fill cover in the five cores collected in the disposal pit ranged from eight inches to five feet with an average fill cover thickness of thirty-five inches (Table 1 in Appendix A; Appendix C).

**Disposal Pit - GPS Data**

Sample ID	Latitude	Longitude
VB-BD-01	40° 01' 51.63472"	105° 12' 28.91990"
VB-BD-06	40° 01' 51.84200"	105° 12' 28.65400"
VB-BD-05	40° 01' 51.71223"	105° 12' 28.31938"
VB-BD-02	40° 01' 51.93939"	105° 12' 27.96698"
VB-BD-04	40° 01' 51.52324"	105° 12' 28.42246"

Readings from the SE International Radiation Alert Inspector instrument of the disposal pit cores ranged from 0.018 to 0.025 mR/hr. Composite surface soil sample VB-BD-RS was collected from the zero to fifteen-cm-bgs interval and composite surface soil sample VB-BD-RD was collected from the fifteen- to thirty-cm-bgs interval in the cores from the primary tailings pond for radiological analysis. The results are in Table 2 and were below the EPA radiation

remediation goals for residential soil. The SPLP analytical results are listed in Table 3. Inorganic concentrations detected were below the of TCLP benchmarks.

#### **4.5 DRUMS, TANKS, TRANSFORMERS**

An inventory and a hazardous classification of the contents of drums, tanks, and transformers on site were conducted August 18 through 20 by UOS. The results are included in a separate report in Appendix D. Chlorine, indicating the likely presence of PCBs, was detected in eight of the nine transformers sampled. Six of the transformers contained chlorine at concentrations indicating the likely presence of greater than 50 ppm PCBs that identifies those transformers as PCB- contaminated electrical equipment subject to disposal requirements specified in 40 CFR 761 (Office of Federal Register 2004). Substances that appeared to be in original containers that were in good condition were assumed to contain the product as labeled and were not sampled. These substances included paints, lubrication oils, and wood finishing products. Twenty-two unlabeled containers were sampled and a field hazardous classification was performed. The samples included seven combustible substances, one corrosive base, one flammable liquid, and one reactive substance. No significant releases appear to have occurred from these containers. Samples of the contents of six drums were collected for XRF analysis. The XRF analytical results for samples VB-SL-02, VB-SL-05, VB-SL-07, VB-SL-09, VB-SL-13, and VB-SL-14 are in Table 4. Concentrations of lead ranged from 76 ppm to 13,000 ppm and concentrations of arsenic were as high as 610 ppm.

#### **4.6 SURFACE SOIL**

Forty-eight surface soil samples, including four duplicates, were collected at forty-four locations on site, including eight background locations and thirty-six locations determined to be potentially contaminated ("Background," "Area," and "Site" samples in Table 4) (Figure 3). The background samples collected included five samples collected along the southern fence and three samples collected on top of the dike west of the mill. The average concentration of lead is 216 ppm and no arsenic was detected above the detection limit that ranged from 13 to 72 and averaged 16 ppm. The concentrations of lead in the five background samples collected along the southern fence ranged from 110 ppm to 500 ppm and indicated that this area may have been previously impacted by wind-blown tailings from the tailings ponds before the tailings were

covered by water and soil. Access was not granted by Xcel to allow for the collection of background soil samples south and east of the site.

At the completion of the radiological survey conducted by CDPHE in 1999, five areas were identified with above background radiation levels. Area 1 through Area 5 are shown on Figure 2 (CDPHE 1999). During this investigation, these areas were surveyed with a Ludlum MicroR Model 19 radiation meter and the background reading was 19 microRoentgens per hour ( $\mu\text{R/hr}$ ). The maximum reading in the area north of the primary pond dike dam (Area 1) was 44  $\mu\text{R/hr}$ , the maximum reading in the area along the old slurry line (Area 2) was 52  $\mu\text{R/hr}$ , the readings in the area in front of the wood shed and around the tree stump (Area 3) were 38  $\mu\text{R/hr}$  and 170  $\mu\text{R/hr}$ , readings in the areas around the mill (Area 4) were as high as 150  $\mu\text{R/hr}$ , and the reading in the ore storage area (Area 5) was 80  $\mu\text{R/hr}$ .

Nine 30-point composite soil samples were collected from the five areas for XRF analysis; analytical results for samples VB-SL-17, VB-SL-18, VB-SL-35, VB-SL-25, VB-SU-11, VB-SU-12, VB-SL-26, and VB-SU13 are included in Table 4 as "Area" samples. Concentrations of lead ranged from 310 ppm to 5,400 ppm. Because of the high concentrations of lead and the interference of lead in arsenic XRF analysis, the detection level for arsenic in many samples was significantly above benchmarks. Arsenic may be present in those samples at concentrations below the detection level specified in the table. Where arsenic was detected, concentrations ranged from 25 ppm to 200 ppm. The XRF analytical results for sample VB-SU-11 collected from the six-foot radius area around the tree stump in Area 3 indicated chromium at a concentration of 3,400 ppm (Superfund Chemical Data Matrix (SCDM) Reference Dose Screening Concentration (RDSC) = 230 ppm), mercury at a concentration of 620 ppm (RDSC = 23 ppm), and barium at a concentration of 11,000 ppm (RDSC = 5,500). Of these five areas, the highest levels of lead and mercury were found on the north side of the dike dam in the primary pond where a spill is known to have occurred sometime in the 1940s (Keeter 2004b). Lead concentrations ranged from 1,600 ppm (zero to one inch bgs) to 5,400 ppm (zero to two feet bgs) and arsenic concentrations ranged from 68 ppm to 200 ppm. The existing vegetation north of the dike dam appears to be reducing the potential for erosion and wind-blown movement.

Twenty-eight soil samples, plus three duplicates, were collected from locations around the mill operation buildings and areas around the tailings ponds ("Site" samples in Table 4).

Concentrations of lead detected ranged from 25 ppm to 4,500 ppm and concentrations of arsenic ranged from 39 ppm to 220 ppm. The highest levels were found in the area west of the three-bay garage (4,400 ppm lead and 140 ppm arsenic at sample location VB-SL-06), in front of the three-bay garage (1,900 ppm lead and 220 ppm arsenic at sample location VB-SL-04), south and west of the mill (1300 ppm lead and 110 ppm arsenic at VB-SL-10), east of the railroad bed, which is devoid of vegetation (4,500 ppm lead at sample location VB-SL-24), on the west side of the mill building (2,700 ppm lead and 110 ppm arsenic), and north of the western dike dam in the secondary tailings pond (2,100 ppm lead and 170 ppm arsenic at VB-SL-29).

Nine soil samples were collected from the site for SVOC analysis. No SVOCs were detected above benchmarks as shown in Table 5. In several SVOC samples, there appears to have been interference, possibly from a non-target list material such as gas, diesel, or other oily substance, especially in samples collected from the floor of the corrugated shed east of the mill (sample location VB-SL-11), under the storage cabinet in the used parts area (sample location VB-SL-12), and under the white drum (sample location VB-SL-22).

People attending sweat lodge ceremonies and other spiritual events are included in the Conceptual Site Model as on-site visitors (Figure 6). On December 12, 2004, three 30-point composite samples were collected from the area where sweat lodge ceremonies are conducted. Three samples were prepared from each composite sample and the nine samples (sample IDs VB-NA-01 through VB-NA-09) (Figure 3) were each analyzed twice on a Niton XRF. ("Sweat Lodge" samples in Table 4). The concentrations of lead detected ranged from 29 to 45 ppm which is well below the residential lead benchmark of 400 ppm.

#### **4.7 RADIOLOGICAL SURVEY**

A radiological investigation of the site was conducted by the EPA Region VIII Radiological Division and UOS. The EPA reports summarizing the findings of the investigation, including a discussion of the results of the radon flux tests, and EPA recommendations are in Appendix E. Radon flux and XRF analytical results are in Appendix I. The results of this investigation are summarized below.

- The findings of the CDPHE 1999 survey were verified with regard to the high radiation readings in Area 1, the north side of the primary pond dike dam, at 70  $\mu\text{R/hr}$  to 75  $\mu\text{R/hr}$  (CDPHE 1999) (Figure 2). A removal of the small pockets of surface soil with radiation readings greater than 60  $\mu\text{R/hr}$  (3 times background) is recommended by EPA.
- The highest radiation readings occurred in Area 3, around the tree stump in front of the wood shop, at 280  $\mu\text{R/hr}$  to 300  $\mu\text{R/hr}$  (Figure 2).
- Radiation readings in Area 5, the ore storage area, are 55  $\mu\text{R/hr}$  to 60  $\mu\text{R/hr}$  (Figure 2).
- Several prairie dog mounds in the primary tailings pond were found to have high radiation readings of 40  $\mu\text{R/hr}$  to 55  $\mu\text{R/hr}$  (Figure in Appendix E). EPA recommends that the cover be properly maintained in accordance with 40 CFR 192.02 and Colorado SB 01-145 by preventing the prairie dogs from burrowing into the tailings ponds and by adding an additional one meter of compacted soil to the cover.
- The soil covers on the tailings ponds and the disposal pit were evaluated with respect to 40 CFR 192.02 requirements for uranium site closures (National Archives and Records Administration 2004). None of the covers meet the 1000-year criteria for erosion control and the primary tailings pond did not meet the 200-year requirement for erosion control.
- Both tailings ponds and the disposal pit met the 40 CFR 192.02(b)(1) radon flux standard by an order of magnitude (National Archives and Records Administration 2004).
- EPA recommends that the City provide an annual letter report to the State documenting the maintenance of the cover in accordance with 40 CFR 192.02, Colorado SB 01-145, and the covenant.

In addition, UOS found high radiation readings in Area 4, the east and west sides of the mill, at 50  $\mu\text{R/hr}$  and in Area 2, along the old slurry line, at 50  $\mu\text{R/hr}$  to 52  $\mu\text{R/hr}$  (Figure 2).

## **5.0 SURFACE WATER AND SEDIMENT PATHWAY**

### **5.1 ANALYTICAL RESULTS**

Surface water pathway sample locations are shown in Figure 4. Four surface soil samples, VB-SU-01 through VB-SU-04, were collected for XRF analysis from the surface water drainage pathways from the site. Concentrations of lead ranged from 90 ppm at sample location VB-SU-04 north and downgradient of the primary pond dike dam to 460 ppm at sample location VB-SU-01 at the southwest corner of the site. No arsenic was detected above the detection limit that ranged from 13 ppm to 21 ppm ("Surface water" samples in Table 4). These results were not elevated above concentrations detected in the eight background surface soil samples collected ("Background" samples in Table 4).

Surface water samples and sediment samples were collected at 10 locations as described in Table 2 of the SAR in Appendix A and shown in Figure 4. Analytical results are in Tables 6 through 11. No inorganic contaminants that can be attributed to the site were detected in surface water above benchmarks. Arsenic was detected in six surface water samples above the SCDM CRSC of 0.057 micrograms per liter ( $\mu\text{g/L}$ ) (Tables 6 and 7). Arsenic is naturally occurring in soils of the western U.S. (USGS 1984). The geometric mean concentration for arsenic in 1,200 samples collected during a 1984 study in the U.S. is 5.2 ppm. The background for the Denver-Boulder area is 8 to 15 ppm (EPA 2001). Arsenic concentrations in groundwater samples collected in the Boulder Creek watershed in October 2000 ranged from 0.07 to 0.85 ppm (Verplanck 2000).

Radiological analytical results for surface water are in Table 8. Drinking water standards were not exceeded at any surface water sample location (Figure 4). No surface water radiological results were elevated above the background samples VB-GW-01, VB-SW/SE-04, and VB-SW/SE-01. The highest adjusted gross alpha radiation level was detected in the on-site wetlands indicating that this wetlands may be impacted by a nearby source; however, the result is significantly below the radiological benchmark. The highest level of gross beta was detected in the Keeter pond; that level is significantly below the standard for man-made isotopes.

Wet chemistry analytical results for surface water are listed in Table 9. Trilinear diagrams and a discussion of them are in Appendix F.

Sediment samples were collected with collocated surface water samples (Figure 4). Sediment inorganic analytical results are listed in Table 10. Arsenic was detected in all of the sediment samples above the SCDM CRSC for soil and in seven samples above the Region 3 RBCs for industrial soil; however, arsenic occurs naturally in the western states at levels above these benchmarks (USGS 1984). None of the sediment samples had levels of lead that were elevated above background. Although a background wetlands sample is not available for comparison, the highest concentrations of lead and arsenic were found in the samples from on-site wetlands and may be at least partially attributable to the tailings that may have migrated by way of the air pathway before the tailings were covered. Thirteen analytes were elevated in samples from one or both of the Ready-Mix pond and the Ben Keeter pond compared to samples from the upgradient Don Rogers pond. The Ready-Mix pond and Ben Keeter pond are located in the Broadway alluvium. The Don Rogers pond is located in the Piney Creek alluvium between two creeks and therefore is not a suitable background location (Figure 4). Of the analytes that are elevated above the concentrations detected in the background sample, only uranium is a contaminant of concern related to activities at the site; however, uranium is also present at similar levels in samples collected all along Butte Mill Ditch, including the Butte Mill Ditch background location. The geometric mean concentration of uranium in soil for the conterminous United States is 2.3 ppm (USGS 1984).

Radiological analytical results for sediment samples are listed in Table 11. No benchmarks are available for radiation in sediment and no results are elevated above background samples (VB-SE-04 and VB-SE-01). The highest gross alpha and gross beta radiation levels were detected in samples collected in Butte Mill Ditch adjacent to the silos and from samples collected from the on-site wetlands (sample location VB-SE-10 on Figure 4). The silos are directly downgradient of the primary pond dike dam. The source of contamination near the silos may have been the spill reported to have occurred through a break in the primary dike dam that reportedly occurred around 1945 (Keeter 2004b). There is no evidence that releases are occurring at present.

## **5.2 TARGET POPULATION**

Approximately 30 miles of wetland frontage exist along Boulder Creek within the 15-mile downstream limit of the site (U.S. Fish and Wildlife Service (USFWS) 1995; USFWS 1996).

Sources, pathways, and receptors are shown on the Conceptual Site Model (Figure 6). Although fishing occurs in the Keeter pond, the fish are not consumed (Keeter 2004c).

Approximately 20 percent to 25 percent of the public water supply for the city of Lafayette is diverted from Boulder Creek at 75<sup>th</sup> Avenue, approximately 1.5 miles downgradient of the probable point of entry (PPE), and serves approximately 5,200 people (City of Lafayette 2004; City of Boulder 2004a; City of Boulder 2004b; City of Louisville 2004).

A potential groundwater to surface water pathway exists and the drinking water target population is listed in the table below. About 40 percent of the city of Boulder's water supply, serving approximately 106,000 people, comes from the Silver Lake/Lakewood Watershed on North Boulder Creek, 40 percent comes from Barker Reservoir on Middle Boulder Creek, and 20 percent comes from Boulder Reservoir, which is part of the Colorado Big Thompson Project. An estimated 20 percent of the Boulder Reservoir falls within the two- to three-mile radius and the remaining eighty percent falls within the three- to four-mile radius. (City of Boulder 2004a; City of Boulder 2004b). About 75 to 80 percent of the city of Lafayette water supply, serving approximately 26,000, comes from Base Line Reservoir that falls within the two- to three-mile radius (City of Lafayette 2004).

**Drinking Water Target Population  
Groundwater to Surface Water Pathway**

<b>Distance From Site</b>	<b>Population</b>
On site	0
>0 to 0.25 mile	0
>0.25 to 0.5 mile	0
>0.5 mile to 1 mile	0
>1 mile to 2 miles	20,800
>2 miles to 3 miles	4,240
>3 miles to 4 miles	16,960
<b>Total</b>	<b>42,000</b>

Sources: City of Boulder 2004a; City of Boulder 2004b; Colorado Department of Natural Resources 2004; City of Louisville 2004; City of Lafayette 2004; USDOC 2000.

The 15-mile downstream limit includes potential habitat for the federal and state designated threatened or endangered species in the table below.

### Threatened and Endangered Species

Common Name	Scientific Name	Status
Preble's meadow jumping mouse	<i>Zapus hudsonius preblei</i>	Federally Threatened State Threatened
whooping crane	<i>Grus americana</i>	Federally Endangered State Endangered
Eskimo curlew	<i>Numenius borealis</i>	Federally Endangered
Mexican spotted owl	<i>Strix occidentalis lucida</i>	Federally Threatened State Threatened
black-footed ferret	<i>Mustela nigripes</i>	Federally Endangered State Endangered
Ute ladies' tresses orchid	<i>Spiranthes diluvialis</i>	Federally Threatened
piping plover	<i>Charadrius melodus</i>	Federally Threatened State Threatened
Canada lynx	<i>Lynx Canadensis</i>	Federally Threatened
greenback cutthroat trout	<i>Oncorhynchus clarki stomias</i>	Federally Threatened State Threatened
Colorado butterfly plant	<i>Gaura neomexicana var. coloradensis</i>	Federally Threatened
boreal toad	<i>Bufo boreas boreas</i>	Federal Candidate State Endangered
bald eagle	<i>Haliaeetus leucocephalus</i>	Federally Threatened State Threatened
burrowing owl	<i>Athene cunicularia</i>	State Threatened
least tern	<i>Sterna antillarum</i>	Federally Endangered State Endangered
lesser prairie-chicken	<i>Tympanuchus pallidicinctus</i>	State Threatened
lynx	<i>Lynx canadensis</i>	Federally Threatened State Endangered
wolverine	<i>Gulo gulo</i>	State Endangered
southwestern willow flycatcher	<i>Empidonax traillii extimus</i>	Federally Endangered State Endangered

Sources: Colorado Division of Wildlife (CDOW) 2004a; CDOW 2004b.

## **6.0 GROUNDWATER PATHWAY**

### **6.1 GROUNDWATER FLOW DIRECTION**

UOS installed four temporary monitoring wells in the alluvial aquifer northwest and north of the site. The wells were installed using the Geoprobe®. The well locations are shown on Figure 5 and lithologic and well construction logs are in Appendix C. The water levels in these wells and the existing on-site wells were measured on September 3, 2004. The elevation of each well casing was also surveyed on September 3, 2004. The groundwater elevations in each well were calculated with this information and are shown on Figure 5 along with contours and groundwater flow directions. One well on site, MW-2, was dry and another on-site well MW-3 was dry after two gallons were purged and did not recharge enough to allow for sample collection.

A detailed groundwater contour map for the entire site could not be produced due to the spacing and location of the Geoprobe® wells in the alluvial aquifer and the limited number of wells in the Pierre Shale south of Valmont Road. In addition, although numerous domestic wells were sampled in the alluvial aquifer north of the site, the groundwater elevations were not measured due to lack of access to the wells. The water elevation measurements in the Geoprobe® wells indicate that groundwater generally flows northeast toward Boulder Creek. The groundwater elevations in the Geoprobe® wells are consistent with the groundwater contours in the USGS publication, "Geohydrology of the shallow aquifers in the Boulder-Longmont Area, Colorado" (USGS 2000) (Figure 5).

The dry wells on the southeast side of the site, MW-2 and MW-3, are indicative that the shale is not an aquifer due to its low permeability. The wells east of the tailings pond that had measurable groundwater, MW-1 and MW-5, are in a slight depression that drains to the north. Based on the lithologic descriptions in the well logs, and the depth to groundwater, the groundwater is in the claystone or silty clay above the shale. Well MW-4 is also located in the drainage near the base of the slope. Based on the lithologic description in the well log, the well was installed in colluvium, rather than the shale.

Groundwater contours for the Pierre Shale were generated for the limited area around the wells for which data were available (Figure 5). The groundwater table slopes toward the north through

the break in the dike, and generally coincides with the surface topography. Well MW-6, located southeast of the tailings dams in the southeast corner of the site had a groundwater elevation of 5,208 feet, which was a higher elevation than the other wells; however, groundwater at MW-6 probably flows east or northeast toward the reservoir based on the surface topography (Figure 4).

## **6.2 ANALYTICAL RESULTS**

Groundwater pathway sample locations are shown in Figure 5. Groundwater samples were collected from seven monitoring wells and analytical results are in Tables 12 through 15. Drinking water samples were collected from 12 domestic wells and the analytical results are in Tables 16 through 19. As shown in Tables 12 and 13, arsenic, chromium, lead, manganese, selenium, thallium, vanadium, and uranium were detected above at least one benchmark in one or more of the Terracon monitoring wells MW-1, MW-4, and MW-6. As stated in Section 3.2, fluorspar ore may contain uranium, radium, thorium, and their respective daughter products, as well as lead, vanadium, chromium, arsenic, copper, zinc, selenium, and molybdenum; therefore, most of the analytes detected above benchmarks may be at least partially attributable to the tailings deposits on site. In addition, the chemistry of the Pierre Shale influences groundwater quality and is noted for elevated concentrations of arsenic, molybdenum, selenium, sulfur, and uranium (Colorado Department of Agriculture Colorado Soil Conservation Board 1985). Table 25 includes inorganic analytical results for a fly ash sample collected in 1998 by Xcel Energy from fly ash disposed on Xcel property (Xcel Energy 1998). Reportedly, all coal has come from Northwest Colorado Coal and is a sub-bituminous coal mined from the Craig, Colorado, area likely to have similar characteristics (Excel Energy 2004).

UOS Geoprobe® monitoring well VB-GW-05 was installed on the north side of the Harley Keeter residence at 6379 Valmont Road to test for potential impact to groundwater related to the primary tailings pond dike dam located immediately south of this residence. The inorganic analytic results in sample VB-GW-05 collected from this well were below all benchmarks. Two Geoprobe® background groundwater wells, VB-GW-01 and VB-GW-02, were installed on City of Boulder Open Space Mountain Parks property. Except for arsenic no drinking water benchmarks were exceeded in sample VB-GW-01. The benchmarks for lead was exceeded in sample VB-GW-02; however, this well is in an area reported to have been a dump (Terracon 2004).

Radiological analytical results for the seven monitoring wells are listed in Table 14. Drinking water standards for the total concentrations of Radium 226 and Radium 228 and adjusted gross alpha were exceeded for the four monitoring wells on site. Radioactive substances may be at least partially attributable to the tailings on site.

The inorganic analytical results for the 12 drinking water wells, VB-DW-01 through VB-DW-12, are listed in Tables 16 and 17. No benchmarks were exceeded in any sample except for arsenic in sample VB-DW-06 collected from the Melton/Mitchell well at 6029 Indian School. The sample had arsenic levels of 1.1 ppb, which are above the EPA SCDM CRSC and Region 3 RBCs for tap water. This well is used for drinking water and the owner has been notified. These arsenic levels can not be attributed to the site. Given the location of this well, the arsenic level in Geoprobe® monitoring well VB-GW-02, and the arsenic level in the Rogers pond, the arsenic is attributable to an upgradient source in the alluvial aquifer (Figure 5).

Radiological analytical results for drinking water are in Table 18. Radiological drinking water standards were not exceeded in any drinking water sample.

Wet chemistry analytical results for groundwater and drinking water are listed in Tables 15 and 19. Trilinear diagrams and a discussion of them are included in Appendix F.

During the FSP planning process, a study to characterize on site and off-site groundwater was considered. Because of the cost and the likely extended time frame to conduct such a study, the best approach was determined to be an investigation of potential targets. If contaminants were found at levels above benchmarks that could potentially be attributable to the site, additional groundwater characterization was to be considered. Because contaminants that can be attributed to the site were not detected above benchmarks in drinking water, additional characterization of potential groundwater movement from the site will not be conducted. Such an investigation would greatly increase the time and cost of the project and provide limited information with regard to human health and the environment.

### 6.3 TARGET POPULATION

The site is not located within a wellhead protection area and is located on the Pierre Shale, which yields water of poor quality not widely used for domestic or municipal purposes. Some concern exists that there is a potential for groundwater contamination from tailings leachate. In most of Boulder County there are no principal water supply aquifers. Minor supply aquifers of the area, including several zones in the Tertiary and Upper Cretaceous, outcrop east of the site. The shallow groundwater, if present, will likely follow the general slope of surface topography (USGS 1997a). Sources, pathways, and receptors are shown on the Conceptual Site Model (Figure 6).

The table below lists the drinking water target population for the groundwater pathway. All domestic wells within four miles of the site and outside of the city of Boulder public water supply system boundary are included. No information regarding the current use status of the wells is available. The assumption is that each well serves one family with an average 3.03 persons per family (USDOC 2000). The domestic wells range in depth from 10 feet to 800 feet bgs (Colorado Department of Natural Resources (CDNR) 2004). No elevated inorganic or radiological substances were detected in nearby wells that were sampled at levels above benchmarks.

**Drinking Water Target Population  
Groundwater Pathway**

Distance From Site	Population
On site	0
>0 to 0.25 mile	29
>0.25 to 0.5 mile	0
>0.5 mile to 1 mile	123
>1 mile to 2 miles	924
>2 miles to 3 miles	1,588
>3 miles to 4 miles	1,709
Total	4,373

Sources: City of Boulder 2004a; City of Boulder 2004b; CDNR 2004; City of Louisville 2004; City of Lafayette 2004; USDOC 2000.

## 7.0 SOIL EXPOSURE PATHWAY

### 7.1 ANALYTICAL RESULTS

Six surface soil samples (VB-SU-05 through VB-SU-10) were collected for XRF analysis from properties north of Valmont Butte. Concentrations of lead detected ranged from 82 ppm to 200 ppm and arsenic was not detected above detection limits that ranged from 13 ppm to 15 ppm (Table 4). Reports of tailings blowing into residential yards have been investigated in the past by the Boulder County Health Department and CDPHE (Boulder City-County Health Department 1972; CDPHE 1972). Since then additional soil has been brought into most yards for landscaping (Keeter 2004b). No evidence exists that current site conditions are impacting residential yards.

### 7.2 TARGET POPULATION

Currently there are no workers on site although the city of Boulder is considering developing the site. The site is partially fenced but is accessible on foot. The two entrance roads are gated and locked. Sources, pathways, and receptors are shown on the Conceptual Site Model (Figure 6).

As shown in the table below, 29 residents live within zero to one-quarter mile of the site and 123 residents live between one-half mile and one mile of the site (USDOC 2000).

**Soil Exposure and Air Pathways - Target Population**

Distance From the Site	Population
On site	0
>0 to 0.25 mile	29
>0.25 to 0.5 mile	0
>0.5 mile to 1 mile	123
>1 mile to 2 miles	8,085
>2 miles to 3 miles	23,379
>3 miles to 4 miles	47,879
Total:	79,495

Source: USDOC 2000

The four-mile radius of influence includes potential habitat for the federally and state designated threatened and endangered species listed in the table in Section 5.2 (CDOW 2004a; CDOW 2004b).

## **8.0 AIR PATHWAY**

Population data are located in the table in Section 7.2 above. A small residential neighborhood is located north of the site and some concerns have been expressed regarding exposure by way of the air pathway during planned construction or ongoing operations. Wind Rose diagrams were included in the FSP as Appendix D (UOS 2004d). In 1972, in response to residents' complaints, an air sample was collected during a period of southeast wind. The Radium-226 (Ra-226) concentration was approximately 20 percent of the Maximum Permissible Concentration for Air ( $MCP_A$ ) for public exposure. Since the  $MCP_A$  applies to a yearly average the determination was made that these infrequent blowing periods would not cause the average concentration to be greater than 1 percent of the  $MCP_A$ . Condition 15 of the Allied Chemical license for radioactive materials states that tailings shall be maintained in a manner as to prevent air or water erosion of the tailings materials and Allied abated the nuisance by keeping the pond wet and seeding the area (CDPHE 1972). The ponds were then covered with clean soil of varying thickness. Although no information is available in files reviewed regarding episodes of blowing tailings since 1972, some areas in the tailings pond have no cover (sample location HMS04) and tailings with elevated concentrations of radioactive substances and lead are being brought to the surface by prairie dogs (sample locations Delta-3, Delta-4, Delta-5, HMS06) (Table 1) (Figure 3). Reportedly during high wind episodes, a cloud of particulate matter is visible above the site (Affleck 2004b).

The air pathway is not currently a pathway of concern. Sources, pathways, and receptors are shown on the Conceptual Site Model (Figure 6). Potential future exposure related to development should be managed to ensure the protection of residents, workers and the environment. The city of Boulder is in the early phases of development and plans for development and operational management are not yet available.

## **9.0     DATA QUALITY ASSESSMENT**

### **9.1     XRF SOIL DATA**

For the XRF soil data, two types of QA/QC samples were collected and analyzed: duplicates and rinsate blanks. An XRF duplicate (D) is a second aliquot prepared for analysis from the soil collected at a sample location. Eleven duplicates were prepared (approximately one per seventeen). A total of four sand rinsate blanks (B) (approximately 1 per 43 samples collected) were analyzed to evaluate conditions in the field laboratory and the decontamination methods used during sample handling. The 15 soil QA/QC samples analyzed represent approximately eight percent of the 186 total soil samples collected or 1 per 11 samples collected.

The 11 duplicate pairs were analyzed by the field laboratory XRF and the lead, uranium, and arsenic results were evaluated to assess sample handling and XRF method precision. For comparison purposes, the Relative Percent Difference (RPD) between each field XRF duplicate pair was calculated and they are presented in Table 20. The typical EPA acceptable QC limit for duplicate pairs evaluation in soils is less than 35% RPD. As shown in Table 20, the RPD was generated only if the metal was detected in both the sample and its duplicate; therefore, eleven RPD values were calculated for lead and only one each for arsenic and uranium. Of these, one value exceeded the QC limit of 35%. In general, the RPD values greater than 35% are indicative of the difficulty of preparing completely homogenized and representative soil samples. The overall duplicate precision QC failure rates of 9% for lead (1 exceedence in 11 pairs) appear acceptable for this type of field laboratory XRF analysis of lead in soil.

The four sand rinsate blanks analyzed using the field laboratory XRF were all non-detect for lead, arsenic, and uranium. One sand blank, VB-BP-02-27B, was sent to Ceimic Corporation for TAL metals analysis. This rinsate blank sample was non-detect for arsenic and mercury. Only low concentrations of two metals were detected (0.40 J milligrams per kilogram (mg/kg) lead and 7.4 J mg/kg uranium) confirming that the decontamination processes used during sampling and handling were sufficient. Iron was detected in both the XRF (180 mg/kg) and laboratory (54.4 mg/kg) results; iron is not one of the contaminants of concern (Table 21).

The Innovex XRF was operated according to the manufacturer's specifications. All XRF data generated for this project were evaluated to ensure that instrument calibration, detection limits, energy calibration checks, blank checks, and field duplicates were within operational control limits (Appendix H). Detection limits were established as a value three times the standard deviation of a low National Institute of Standards and Technology (NIST) certified standard, and run a minimum of seven times over a specified period of time. In the case of arsenic, the detection limit is three times the standard deviation or one-tenth of the lead concentration for that sample, whichever is greater.

A total of 38 XRF samples were sent to Ceimic Corporation for collaborative analysis and 31 samples, 17 percent of the samples collected, were analyzed for inorganics. The results are in Tables 22 and 23. The collaborative samples were chosen by randomly selecting samples from low, medium, and high lead concentration ranges to ensure the collaborative samples included a range of concentrations. A label containing the Sample ID was attached to each sample container and the samples were shipped under Chain of Custody (COC).

The results of the fixed laboratory collaborative analyses were compared to the results of the field laboratory XRF analyses for the collaborative data set using linear regression analysis (EPA 2004e). The data used for this analysis are in Table 24. While lead and arsenic are the metals of most concern at the site, the arsenic values are skewed and can not be correlated. High amounts of lead create an interference in the arsenic XRF spectra, which causes a high bias in the XRF arsenic results. All of the collaborative samples with an arsenic detection have a high value for lead and an obvious high bias is present. Of 38 collaborative samples sent to the lab, 37 have lead values above the Method Detection Limit (MDL) for both XRF and lab data and can be used for a correlation. The figure in Appendix G shows the scatterplot with linear regression line and analysis results. Note that most outliers in the scatterplot have lead values greater than 1000 ppm. Some possible reasons for outliers in the data would include segregation or settling of particles in the XRF cup during shipping and the fact that the lab used only approximately 1 gram of the available 6 or 7 grams in the XRF cup, both of which would skew the result. A slight high bias is seen on XRF results less than 2,500 ppm. This is desirable as it adds a buffer for increased error of the XRF results. The correlation coefficient (R) for the regression was 0.969 (The UOS Generic QAPP specifies a value of  $R > 0.70$  for collaborative data to be valid (UOS

2004b)). This R value demonstrates a clear correlation between the XRF and lab results. The XRF data are acceptable for their intended use.

## **9.2 CHLOR-IN-OIL**

As described in the Hazardous Classification report, samples were collected from oil in, or soil under, nine transformers and analyzed for PCBs using Chlor-in-Oil or Chlor-in-Soil field analytical kits. Sample #1 was sent to the laboratory as a collaborative sample. Aroclor 1016 was detected at 98 ppm confirming the results of the Chlor-in-Oil test, which indicated that the transformer contained PCBs at greater than 50 ppm.

## **9.3 CLP DATA REVIEW AND INTERPRETATION**

The sample data collected during this SR were reviewed using the HRS guidelines for analytical interpretation (Office of the Federal Register 1990). Elevated concentrations of contaminants reported as significantly above upgradient contaminant values are noted by a star (★) in tables and are determined by sample concentrations based on the following:

- If the upgradient analyte concentration is greater than its Sample Quantitation Limit (SQL), and if the release sample analyte concentration is greater than its SQL, three times greater than the upgradient, and five times greater than the blank concentration.
- If the upgradient analyte concentration is not greater than its SQL and if the release sample analyte concentration is greater than its SQL, greater than the upgradient SQL, and five times greater than the blank analyte concentration.

None of the pathway analytical data results for this project were elevated above upgradient (background) concentrations.

All data analyzed by the CLP Routine Analytical Services (RAS) laboratories were reviewed by TechLaw, Inc. All data are acceptable for use as qualified in the data validation reports. The data validation reports and laboratory forms are under separate cover in Appendix I. CLP data packages were reviewed according to the EPA CLP National Functional Guidelines for Inorganic

Data Review (EPA 2004f). Raw data were reviewed for completeness and transcription accuracy onto the summary forms. Approximately 10 percent to 20 percent of the results reported in each of the samples, calibrations, and QC analyses were recalculated and verified. If problems were identified during the recalculation of results, a more thorough calculation check was performed.

For inorganic analytical results in soil, data qualifications resulted for holding time being exceeded for mercury, blank contamination for uranium, out-of-range recovery on interference checks, out-of range spike recoveries, and out-of-range serial dilution results. Lead was qualified in all 18 samples of one data package because the duplicate criteria was not met. While lead is the primary indicator, the qualifiers applied do not significantly impact the overall results and the data are acceptable for their intended use.

For inorganic analytical results in sediment, some data were qualified due to blank contamination, out-of-range percent recovery in Interference Check Sample (ICS) solutions, out-of-range spike recoveries, and unmet duplicate criteria; however, qualifiers were not applied to significant indicator contaminants of concern and data are acceptable for their intended use.

For inorganic analytical results in water, qualifications occurred for out-of-range recovery in calibration verification, out-of-range recovery for Inductively Coupled Plasma (ICP) standards, blank contamination, out-of range recovery in ICS solutions, out-of-range recovery for continuing calibration, and out-of-range spike recovery. Uranium was qualified because of blank contamination and because internal standards did not bracket the analyte mass. In some samples arsenic was qualified because of an out-of-range Contract Required Detection Limit (CRDL) standard required for ICP (CRI) recovery or because of blank contamination. The qualifiers applied to indicator contaminants of concern do not significantly impact the results and the data are acceptable for their intended use.

An unusual trend was observed in many of the water samples; 44% of the dissolved metals concentrations are higher than the total metals concentrations for calcium, sodium, and magnesium. Total metal concentrations are generally much higher due to metals that are digested from the sediment in the water sample. A review of the raw data by a START chemist revealed no obvious reasons for the unusual results. Since most of the results are within 10% of each

other and the data concerned are not critical for site decisions, the data is suitable for its intended use.

For semivolatile organics in soil, qualifiers were applied to analytical results for blank contamination and insufficient continuing calibration. The data are acceptable for their intended use.

#### **9.4 NON-CLP DATA REVIEW AND INTERPRETATION**

All data analyzed by the Severn Trent Laboratories and ERG were reviewed by a UOS chemist. All data are acceptable for use as qualified in the data validation reports. The data validation reports and laboratory forms are under separate cover in Appendix I. Non-CLP data packages were reviewed according to the EPA CLP National Functional Guidelines for Inorganic Data Review (October 2004) or the "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review" (October 1999), modified for the methods used. Raw data were reviewed for completeness and transcription accuracy onto the summary forms. Approximately 10 percent to 20 percent of the results reported in each of the samples, calibrations, and QC analyses were recalculated and verified. If problems were identified during the recalculation of results, a more thorough calculation check was performed.

All water samples were flagged due to exceeded hold times for nitrate and nitrite analysis. The hold time for nitrate/ nitrite analysis is 48 hours. Since all samples were analyzed within 96 hours of collection (twice the holding time), only "J" flags are necessary. Microbial activity converts nitrate to nitrite, thus all nitrate detections will be flagged "J-" and all nitrite detections will be flagged "J+."

For inorganic metals analysis for soil and SPLP leachate analyses, some data were qualified due to blank contamination, and negative blank contamination; however, qualifiers were not applied to significant indicator contaminants of concern and data are acceptable for their intended use.

Semivolatile and radiological analytical data are acceptable for their intended use with no qualifications applied. The groundwater sample VB-TW-06 had a gross alpha value of 418 picocuries per liter (Pci/L), while the field duplicate of the same sample (VB-TW-07) had a gross

alpha value of 118 Pci/L. This gives a RPD of 112 percent. This discrepancy is probably due to alpha attenuation caused by the uneven deposition of sediment on the stainless steel planchet. Since the water in these samples comes directly from a well, it is probable that the sample contains high levels of suspended solids. If these suspended solids are deposited unevenly on to the planchet, the sediment itself will absorb some of the alpha radiation, creating a low bias in the result.

## **10.0 SCREENING LEVEL RISK EVALUATION**

A non-radiological, human health, screening level risk evaluation was performed by an EPA Region VIII toxicologist (Appendix H). A screening level evaluation is intended to provide a general assessment of risk without knowledge of the specific parameters relevant to the site, such as exposure conditions and relative bioavailability of contaminants. It represents a generalized, non-quantitative evaluation of risk based on comparison of analytical data collected from the site with generic screening level RBCs. The screening level approach is conservative since many of the default assumptions used to derive the RBCs are conservative. In addition, in order for risk to human health to occur, there must be a complete exposure pathway that includes 1) a source of contamination, 2) a release to the environment, 3) a transport pathway to a receptor, and 4) an ingestion, inhalation, or dermal exposure route (Figure 6).

Analytical results indicate that lead concentrations in soil samples collected exceed the Lead Sites Workgroup industrial benchmark of 800 ppm (EPA 2004g). This benchmark was selected for use because the state of Colorado, EPA Region VIII, and EPA Region III have not finalized a lead benchmark as of the date of this report. Concentrations above the industrial benchmark were detected in surface soil samples collected from the primary tailings pond soil cover, prairie dog mounds in the primary tailings pond, the hillside north of the three dike dams, the area around the tree stump in front of the wood shop, around the mill building, north and west of the three-bay garage, and east of the railroad bed. Concentrations above the industrial benchmark were also detected in subsurface soil samples collected from the primary and secondary tailings ponds and the primary tailings pond dike dam and in samples collected from the contents of drums (Tables 1 and 4). Concentrations of lead in residential soil samples did not exceed the EPA residential screening value for lead of 400 ppm (EPA 2003). Concentrations of arsenic were above RBCs but were generally consistent with background levels of 8 ppm to 15 ppm for the region (EPA 2001). Arsenic in some samples collected from tailings were above background levels.

Although the concentration of arsenic in one drinking water sample exceeded the RBC, the concentration did not exceed the new MCL for arsenic that becomes effective January 23, 2006 (EPA 2004b).

Risks to off-site human receptors are unlikely to be significant. Hazardous contaminants on site may pose a risk to potential on-site receptors. Risks to construction workers can be minimized with the implementation of an appropriate health and safety plan and engineering controls. Risk to future on-site workers can be minimized with the implementation of appropriate administrative and institutional controls, such as restrictions limiting or preventing worker exposure to surface or subsurface soils.

Risks associated with Native American cultural practices (e.g., sweat lodge ceremonies) are also unlikely to be significant. Focused sampling of surface soils in the on-site area where such ceremonies are currently held indicate that concentrations of lead ranged from 46 to 72 ppm, significantly less than the residential screening level for lead (400 ppm).

## **11.0 SUMMARY**

The 102-acre Valmont Butte / Allied Piles site includes historic mill operations covering approximately eight acres on the western end and two soil-covered tailings ponds covering approximately seventeen acres in the center of the site. Valmont dike runs the entire length of the property on the north side. The two entrance roads are gated and locked. The site is partially fenced but is accessible on foot. Recreational attractions to the site include the Valmont dike and the mill buildings; evidence of trespassing includes broken locks on mill building doors.

The major sources on the site are :

- Tailings located in the primary tailings pond and the primary pond dike dam;
- Tailings located in the secondary tailings pond;
- Radium-contaminated construction debris buried in a disposal pit;
- Drums, tanks, and transformers remaining on site from previous operations; and
- Small areas of surface soil.

Primary contaminants of concern in the tailings include radium-226, lead, and arsenic. No evidence exists that contaminants are currently being released off-site in a manner that is a significant risk to human health or the environment.

Hazardous substances remaining on site in transformers, tanks, drums, and other labeled and unlabeled containers were inventoried during this investigation and should be removed from the site and properly disposed. Combustible, corrosive, flammable, and reactive substances were characterized. Contaminated soil outside the tailings ponds should be addressed during the development planning phase. In the historic mill operations area analytical results indicate high levels of lead and high levels of unregulated substances such as gasoline or diesel in some areas. No hazardous releases related to the drums, tanks, or the transformers were observed.

In the primary tailings pond the soil cover ranges from 10 inches to 24 inches with an average thickness of 17 inches. However, there appears to be no fill cover in some small areas, such as a sample location where 3,400 ppm lead was detected at the surface. In addition, prairie dogs have burrowed into the primary tailings pond and brought tailings to the surface where lead was detected at concentrations of as much as 3,296 ppm. The volume of fluorspar tailings is estimated to be 327,000 cubic yards and the

volume of gold tailings is estimated to be 45,000 cubic yards. The primary tailings pond dike dam is constructed primarily of tailings. The radiological concentrations in samples collected from a core from the primary tailings pond dike dam were the highest levels detected in source samples. SPLP results indicate that inorganic substances from the tailings are unlikely to leach into the groundwater. The highest radiological readings in cores occurred in the core collected from the primary dam.

The volume of fluorspar tailings in the secondary tailings pond is estimated to be 70,000 cubic yards. The fill cover ranged from 16 inches to 36 inches. Prairie dogs have also burrowed into the secondary tailings pond. Lead was detected at 183 ppm in the composite subsurface soil sample. The SPLP analysis indicated that the probability of metals leaching out of the tailings is not significant.

A radiological survey conducted by EPA confirmed that the highest remaining radiation levels are in the areas previously identified by CDPHE: north of the primary tailings pond dike dam, along the location of the slurry line, around the tree stump in front of the work shop, east and west of the mill, and the ore storage area. In addition, some of the prairie dog mounds in the primary tailings pond had high radiation levels.

Domestic wells north of the site were sampled for inorganics and radioactivity that could be related to site activities. The Melton/Mitchell well at 6029 Indian School has arsenic levels of 1.1 ppb, which are above the EPA SCDM CRSC and Region 3 RBCs for tap water but below the MCL. This well is used for drinking water and the owner has been notified. These arsenic levels can not be attributed to the site. No other drinking water benchmarks were exceeded in any other domestic well samples.

Analytical results do not indicate that the surface water pathway is being significantly impacted by present conditions or historic activities at the site. Arsenic was found above benchmarks in all samples including background samples but can not be specifically attributed to the site. The wetland at the east end of the site appears to have been impacted at least partially by historic activities at the site. There is no evidence that releases into the downstream surface water pathway are occurring at this time.

Surface soil analytical results for samples collected in residential yards along Valmont Road do not indicate a release to the soil exposure pathway.

All of the major Data Quality Objective study questions listed in the FSP have been answered. Based on professional judgement all of the significant sources on site have been identified and characterized. Although the extent to which leachate could permeate the fractured Pierre Shale and impact drinking water wells north of the site is unknown, analytical data do not indicate that this is happening at a level that poses a significant risk to human health and the environment. Specific hydrogeologic data would not significantly alter the findings of this investigation.

A non-radiological, human health, screening level risk evaluation was performed by an EPA Region VIII toxicologist. Risks to off-site human receptors are unlikely to be significant; however, hazardous contaminants on site may pose a risk to potential on-site receptors unless good management practices are followed during development and ongoing operations. Engineering and management controls should be in place to address the potential increased risk related to development plans.

The analytical results do not indicate there will be a significant risk related to the intended use of the property. No evaluation of site plans related to potential risk can be conducted at this time since the city is in the early stages of engineering and design work. Surface areas identified as having high concentrations of radioactive substances or lead should be remediated as part of the development process. When the site is fully developed a radiological and lead survey may be advisable to address concerns related to hazardous materials being exposed as a result of development activities.

No complete pathways were identified during this investigation. If complete pathways existed, the potential receptors at the site include construction workers, industrial and commercial workers, visitors for recreational or permitted spiritual events, cemetery visitors using the parking area on site, and trespassers. Potential receptors off-site include nearby residents, domestic and commercial groundwater users, cemetery visitors, consumers of farm produce, workers, wetlands, wildlife, fisheries, and city of Lafayette drinking water users.

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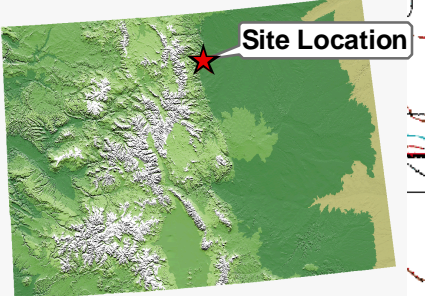
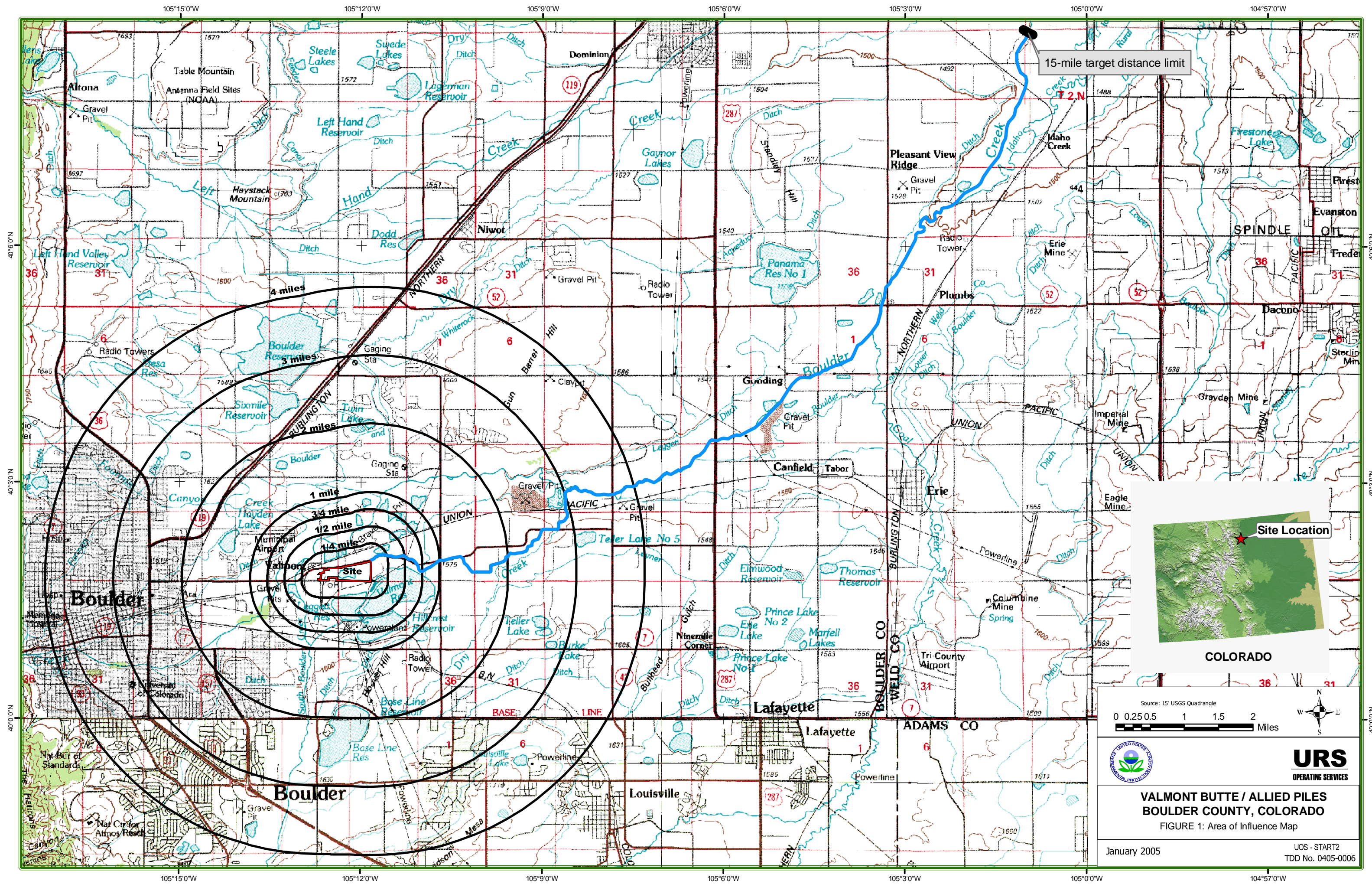
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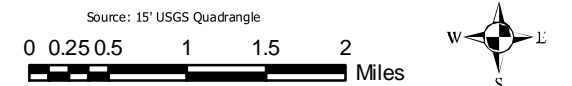
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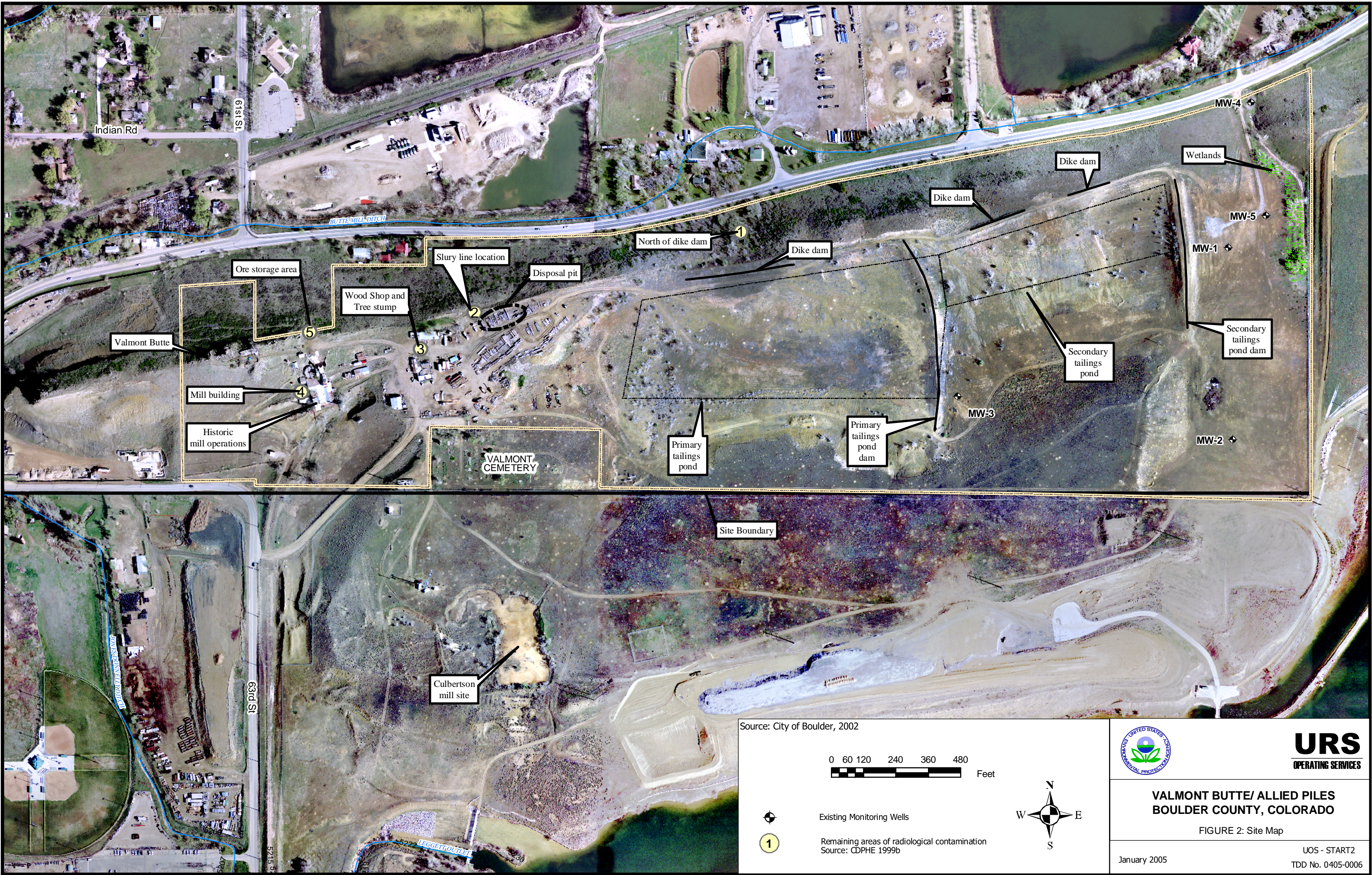
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**VALMONT BUTTE / ALLIED PILES  
BOULDER COUNTY, COLORADO**

FIGURE 1: Area of Influence Map

January 2005

UOS - START2  
TDD No. 0405-0006



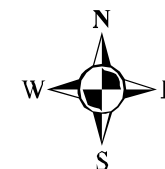
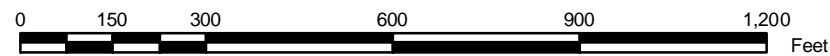


**Legend**

**Sample locations**

- Soil Bore Location Sampled
- Soil Bore Location Not Sampled
- ★ Soil Gas Sample Location
- Fly Ash Sample Location
- Soil Sample Location
- START2 Soil Sample Location
- Radiological Survey Location

- ▭ Tailings Ponds
- ▭ Site Boundary
- ~ Roads



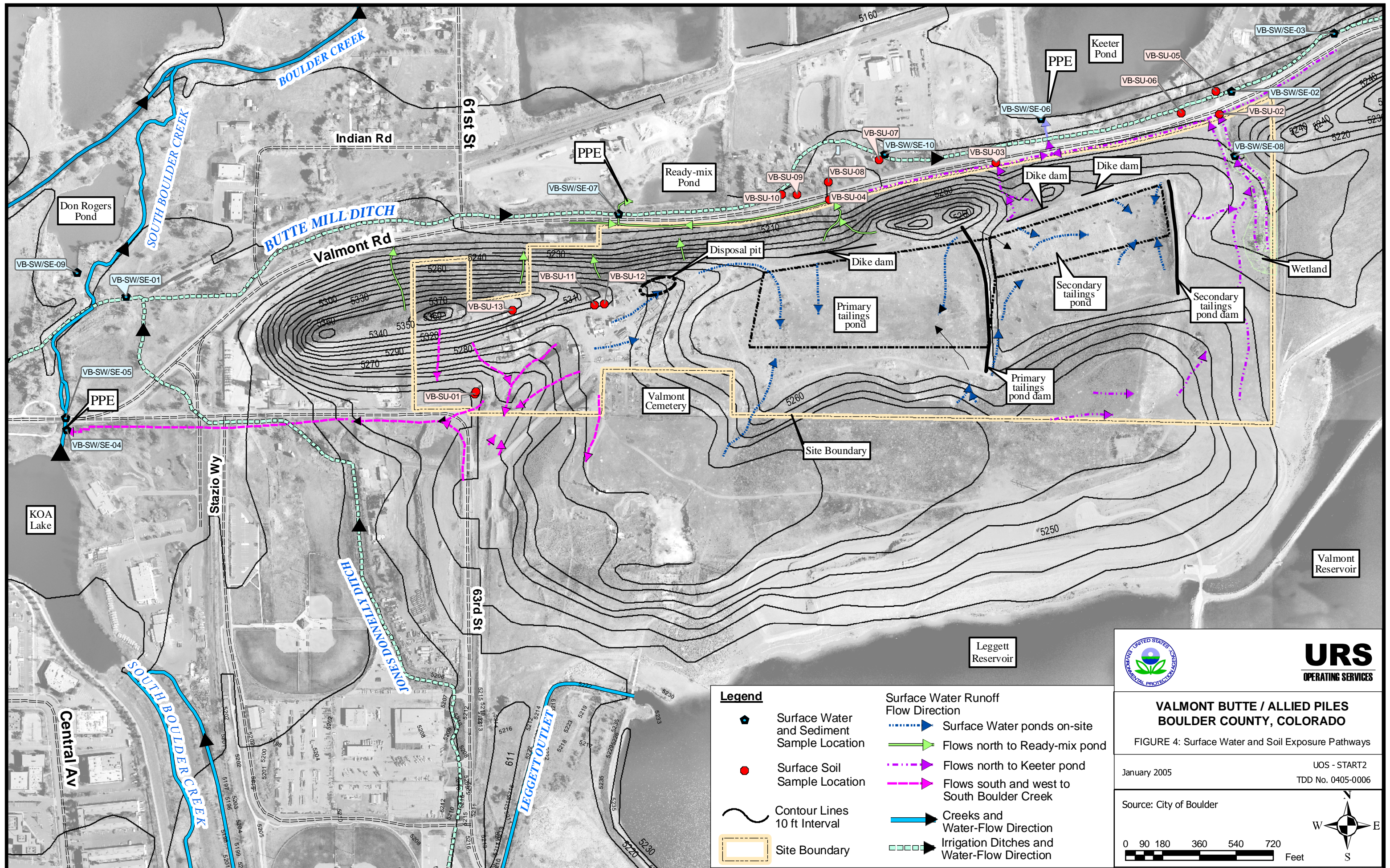
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BOULDER COUNTY, COLORADO**

FIGURE 3: Source Sample Location Map



January 2005

UOS - START2  
TDD No. 0405-0006



**Legend**

- Surface Water and Sediment Sample Location
- Surface Soil Sample Location
- Contour Lines 10 ft Interval
- Site Boundary
- Surface Water Runoff Flow Direction
  - Surface Water ponds on-site
  - Flows north to Ready-mix pond
  - Flows north to Keeter pond
  - Flows south and west to South Boulder Creek
  - Creeks and Water-Flow Direction
  - Irrigation Ditches and Water-Flow Direction



**VALMONT BUTTE / ALLIED PILES**  
**BOULDER COUNTY, COLORADO**


FIGURE 4: Surface Water and Soil Exposure Pathways

January 2005

Source: City of Boulder

UOS - START2  
TDD No. 0405-0006

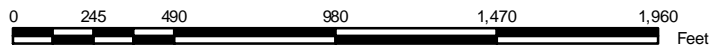
0 90 180 360 540 720 Feet





**Legend**

- |   |                             |
|---|-----------------------------|
| ▲ Drinking Water Sample Location                              | ■ Drinking Water Study Area |
| ◆ Groundwater Well Sample Location with groundwater elevation | ■ Tailings Ponds            |
| - - - Groundwater Contour line with elevation                 | ■ Site boundary             |
| ➡ Groundwater Flow Direction                                  | ~ Roads                     |
| — Creeks and Ditches  |                             |



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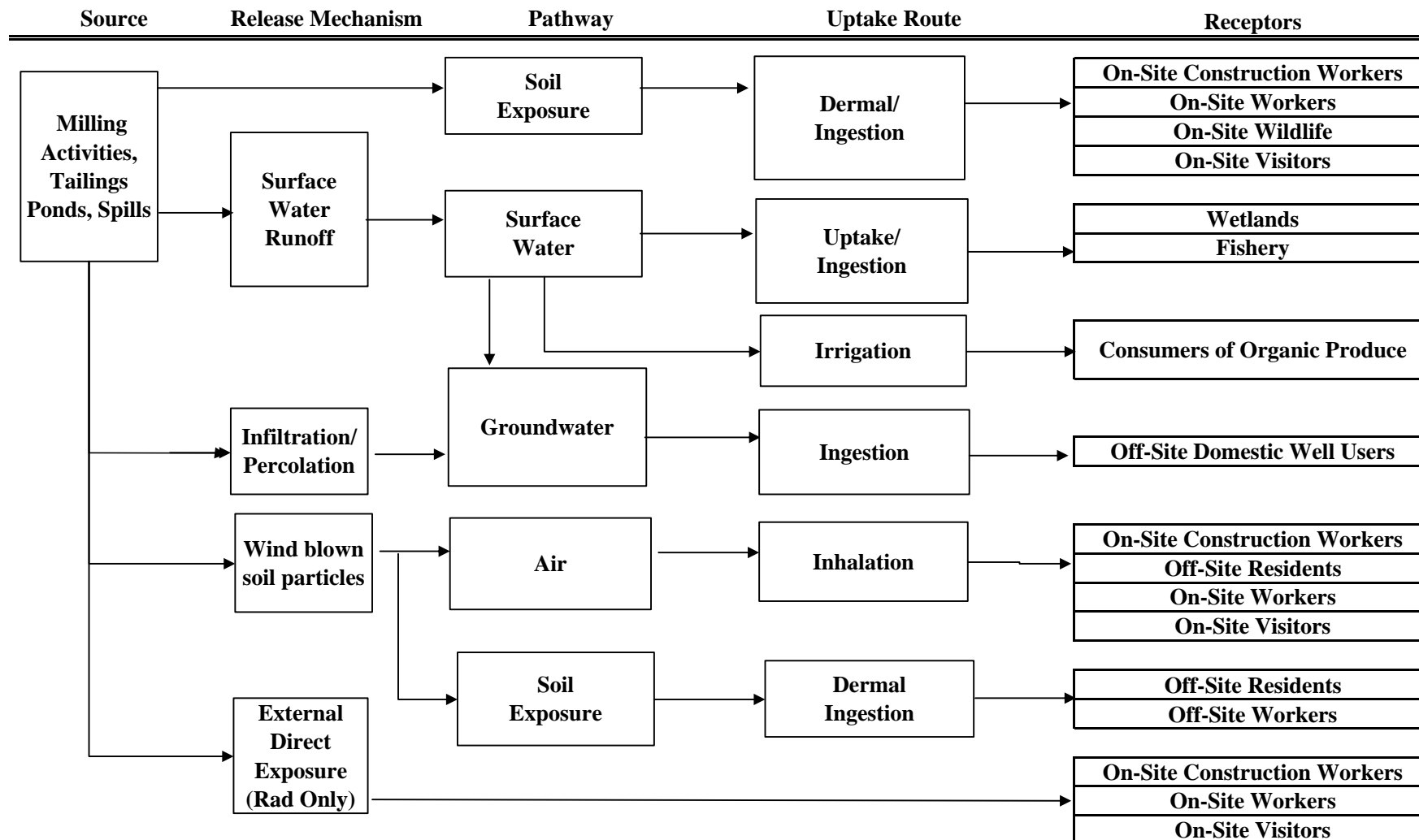
FIGURE 5: Groundwater Pathway

January 2005

UOS - START2  
TDD No. 0405-0006

Figure 6

## VALMONT BUTTE / ALLIED PILES - CONCEPTUAL SITE MODEL



**TABLE 1**  
**Source Samples XRF Analytical Results**  
**(Concentrations in parts per million (ppm))**

Sample ID	Sample Location	Pb	U	As	Hg
	<b>SCDM RDSC Benchmark</b>	-	-	23	23
	<b>SCDM CRSC Benchmark</b>	-	-	0.43	-
	<b>RBC Industrial Benchmarks (Pb is from EPA Lead Sites Workgroup)</b>	800	200 N	1.9 C	-
<b>Surface Soil/Soil Cover</b>					
Delta-3	Primary Tailings Pond Prairie Dog Mound - composite sample 0 to 1 in bgs	3,300	2.7**	330 U	23 U
Delta-4	Primary Tailings Pond Prairie Dog Mound - composite sample 0 to 1 in bgs	2,300	8.2**	230 U	21 U
Delta-5	Primary Tailings Pond Prairie Dog Mound - composite sample 0 to 1 in bgs	3,300	4.9**	330 U	20 U
HMS01	Primary Tailings Pond Prairie Dog Mound - composite sample 0 to 1 in bgs	1,400	16 U	140 U	72 U
HMS03	Primary Tailings Pond Prairie Dog Mound - composite sample 0 to 1 in bgs	980	16 U	98 U	90 J
HMS04	Primary Tailings Pond - composite sample 0 to 1 in bgs	3,400	23 J	340 U	150 J
HMS05	Primary Tailings Pond Prairie Dog Mound - composite sample 0 to 1 in bgs	610	24 J	69 U	84 J
HMS06	Primary Tailings Pond Prairie Dog Mound - composite sample 0 to 1 in bgs bgs	2,400	16 U	240 U	87 J
HMS07	Primary Tailings Pond Prairie Dog Mound - composite sample 0 to 1 in bgs	890	24 J	89 U	130 J
VB-BD-MO-01	Disposal Pit composite sample 0 to 1 in bgs	19*	35 U	42 U	18 U
VB-BD-MO-02	Disposal Pit composite sample 0 to 1 in bgs	56 J	22 U	13 U	14 U
VB-BD-MO-03	Disposal Pit composite sample 0 to 1 in bgs	20 J	22 U	13 U	14 U
VB-BD-MS-01	Disposal Pit composite sample 1 to 18 in bgs	43 J	22 U	13 U	14 U
VB-BD-MS-02	Disposal Pit composite sample 1 to 18 in bgs	47 J	22 U	13 U	14 U
VB-BD-MS-03	Disposal Pit composite sample 1 to 18 in bgs	56 J	23 U	13 U	14 U
VB-SG-11	Primary Tailings Pond - composite sample 0 to 1 in bgs	36 J	23 U	13 U	14 U
VB-SG-12	Primary Tailings Pond - composite sample 0 to 1 in bgs	56 J	24 U	13 U	14 U
VB-SG-13	Primary Tailings Pond - composite sample 0 to 1 in bgs	59	22 U	13 U	14 U
VB-SG-14	Primary Tailings Pond - composite sample 0 to 1 in bgs	50 J	23 U	13 U	14 U
VB-SG-15	Primary Tailings Pond - composite sample 0 to 1 in bgs	200	22 U	14 U	14 U
VB-SG-16	Primary Tailings Pond - composite sample 0 to 1 in bgs	42 J	23 U	13 U	14 U
VB-SG-17	Primary Tailings Pond - composite sample 0 to 1 in bgs	44 J	22 U	13 U	14 U
VB-SG-18	Primary Tailings Pond - composite sample 0 to 1 in bgs	230	22 U	15 U	14 U

**TABLE 1**  
**Source Samples XRF Analytical Results**  
**(Concentrations in parts per million (ppm))**  
**(continued)**

Sample ID	Sample Location	Pb	U	As	Hg
	SCDM RDSC Benchmark	-	-	23	23
	SCDM CRSC Benchmark	-	-	0.43	-
	RBC Industrial Benchmarks (Pb is from EPA Lead Sites Workgroup)	800	200 N	1.9 C	-
VB-SG-19	Primary Tailings Pond - composite sample 0 to 1 in bgs	74	22 U	13 U	14 U
VB-SG-20	Primary Tailings Pond - composite sample 0 to 1 in bgs	41 J	22 U	13 U	14 U
VB-SG-21	Primary Tailings Pond - composite sample 0 to 1 in bgs	51 J	22 U	13 U	14 U
VB-SG-22	Primary Tailings Pond - composite sample 0 to 1 in bgs	57 J	23 U	13 U	14 U
VB-SG-22D	Primary Tailings Pond - composite sample 0 to 1 in bgs	60	23 U	13 U	14 U
VB-SG-23	Primary Tailings Pond - composite sample 0 to 1 in bgs	94	22 U	13 U	14 U
VB-SG-24	Primary Tailings Pond - composite sample 0 to 1 in bgs	1,300	28 U	34 U	18 U
VB-BP-MO-01	Primary Tailings Pond - composite sample 0 to 1 in bgs	47 J	22 U	13 U	14 U
VB-BP-MO-02	Primary Tailings Pond - composite sample 0 to 1 in bgs	60 J	21 U	13 U	14 U
VB-BP-MO-03	Primary Tailings Pond - composite sample 0 to 1 in bgs	190	24 U	15 U	14 U
VB-BP-MS-01	Primary Tailings Pond - composite sample 1 to 18 in bgs	310	23 U	31 J	15 U
VB-BP-MS-02	Primary Tailings Pond - composite sample 1 to 18 in bgs	340	24 U	18 U	14 U
VB-BP-MS-03	Primary Tailings Pond - composite sample 1 to 18 in bgs	64	22 U	13 U	14 U
VB-SG-25	Secondary Tailings Pond - composite sample 0 to 1 in bgs	190	22 U	14 U	14 U
VB-SG-26	Secondary Tailings Pond - composite sample 0 to 1 in bgs	77	21 U	13 U	14 U
VB-SG-27	Secondary Tailings Pond - composite sample 0 to 1 in bgs	340	24 U	18 U	14 U
VB-SG-28	Secondary Tailings Pond - composite sample 0 to 1 in bgs	250	23 U	16 U	14 U
VB-SG-29	Secondary Tailings Pond - composite sample 0 to 1 in bgs	39 J	23 U	13 U	14 U
VB-SG-30	Secondary Tailings Pond - composite sample 0 to 1 in bgs	190	24 U	14 U	14 U
VB-BS-38-01	Secondary Tailings Pond - grab sample location VB-BS-38 1.5 to 2 ft bgs	34 J	24 U	13 U	14 U
VB-BS-39-01	Secondary Tailings Pond - grab sample location VB-BS-39 1.5 to 2 ft bgs	21 J	22 U	13 U	14 U
VB-BS-MO-01	Secondary Tailings Pond - composite sample 0 to 1 in bgs	240	24 U	16 U	14 U
VB-BS-MO-02	Secondary Tailings Pond - composite sample 0 to 1 in bgs	370	23 U	18 U	15 U
VB-BS-MO-03	Secondary Tailings Pond - composite sample 0 to 1 in bgs	360	24 U	18 U	14 U

**TABLE 1**  
**Source Samples XRF Analytical Results**  
**(Concentrations in parts per million (ppm))**  
**(continued)**

Sample ID	Sample Location	Pb	U	As	Hg
	<b>SCDM RDSC Benchmark</b>	-	-	<b>23</b>	<b>23</b>
	<b>SCDM CRSC Benchmark</b>	-	-	<b>0.43</b>	-
	<b>RBC Industrial Benchmarks (Pb is from EPA Lead Sites Workgroup)</b>	<b>800</b>	<b>200 N</b>	<b>1.9 C</b>	-
VB-BS-MO-03D	Secondary Tailings Pond - composite sample 0 to 1 in bgs	360	24 U	19 U	15 U
VB-BS-MS-01	Secondary Tailings Pond - composite sample 1 to 18 in bgs	440	25 U	21 U	15 U
VB-BS-MS-02	Secondary Tailings Pond - composite sample 1 to 18 in bgs	430	24 U	21 U	15 U
VB-BS-MS-03	Secondary Tailings Pond - composite sample 1 to 18 in bgs	380	24 U	19 U	15 U
VB-DP-MO-01	Primary Tailings Pond Dike Dam - 0 to 1 in bgs	560	27 U	23 U	17 U
VB-DP-MS-01	Primary Tailings Pond Dike Dam - composite sample 1 to 18 in bgs	210	24 U	15 U	14 U
VB-DP-MS-02	Primary Tailings Pond Dike Dam - composite sample 1 to 18 in bgs	200	23 U	14 U	14 U
VB-DP-MS-03	Primary Tailings Pond Dike Dam - composite sample 1 to 18 in bgs	140	24 U	13 U	14 U
<b>Subsurface Soil/ Tailings</b>					
VB-BD-01-06	Disposal Pit grab sample location VB-BD-01 6.5 to 7 ft bgs	17 U	22 U	13 U	14 U
VB-BD-02-02	Disposal Pit grab sample location VB-BD-02 2.5 to 3 ft bgs	28 J	22 U	13 U	14 U
VB-BD-03-04	Disposal Pit grab sample location VB-BD-03 4.5 to 5 ft bgs	2,200	26 U	84	21 U
VB-BD-03-07	Disposal Pit grab sample location VB-BD-03 7.5 to 8 ft bgs	17 U	21 U	13 U	14 U
VB-BD-04-03	Disposal Pit grab sample location VB-BD-04 3.0 to 3.25 ft bgs	30 J	24 U	13 U	14 U
VB-BD-05-06	Disposal Pit grab sample location VB-BD-05 6.5 to 7 ft bgs	24 J	22 U	13 U	14 U
VB-BD-06-02	Disposal Pit grab sample location VB-BD-06 2.0 to 2.5 ft bgs	17 U	21 U	13 U	14 U
VB-BD-MD-01	Disposal Pit composite sample 2 ft bgs to depth	60	22 U	13 U	14 U
VB-BD-MD-02	Disposal Pit composite sample 2 ft bgs to depth	31 J	22 U	13 U	14 U
VB-BD-MD-03	Disposal Pit composite sample 2 ft bgs to depth	39 J	23 U	13 U	14 U
VB-BP-02-02	Primary Tailings Pond - grab sample location VB-BP-02 2.0 to 2.5 ft bgs	5,800	36 U	83 U	28 U
VB-BP-02-12	Primary Tailings Pond - grab sample location VB-BP-02 12 to 12.5 ft bgs	3,000	35 U	55 U	23 U
VB-BP-02-27	Primary Tailings Pond - grab sample location VB-BP-02 27 to 27.5 ft bgs	780	33 U	29 U	18 U
VB-BP-05-02	Primary Tailings Pond - grab sample location VB-BP-05 2.25 to 2.75 ft bgs	1,700	25 U	39 U	19 U
VB-BP-05-07	Primary Tailings Pond - grab sample location VB-BP-05 7.5 to 8 ft bgs	1,200	230	39 J	20 U

**TABLE 1**  
**Source Samples XRF Analytical Results**  
**(Concentrations in parts per million (ppm))**  
**(continued)**

Sample ID	Sample Location	Pb	U	As	Hg
	SCDM RDSC Benchmark	-	-	23	23
	SCDM CRSC Benchmark	-	-	0.43	-
	RBC Industrial Benchmarks (Pb is from EPA Lead Sites Workgroup)	800	200 N	1.9 C	-
VB-BP-05-09	Primary Tailings Pond - grab sample location VB-BP-05 9.0 to 9.5 ft bgs	14,000	120	150 U	61
VB-BP-05-14	Primary Tailings Pond - grab sample location VB-BP-05 14.5 to 15 ft bgs	3,700	47	62 U	24 U
VB-BP-05-19	Primary Tailings Pond - grab sample location VB-BP-05 19.5 to 20 ft bgs	4,900	77	74 U	30 U
VB-BP-05-22	Primary Tailings Pond - grab sample location VB-BP-05 22.5 to 22.75 ft bgs	1,500	64	40 U	21 U
VB-BP-05-22D	Primary Tailings Pond - grab sample location VB-BP-05 22.5 to 22.75 ft bgs	1,600	63	42 U	22 U
VB-BP-05-35	Primary Tailings Pond - grab sample location VB-BP-05 35 ft bgs	1,000	49	32 U	18 U
VB-BP-07-02	Primary Tailings Pond - grab sample location VB-BP-07 2.25 to 2.5 ft bgs	2,300	29 U	47 U	18 U
VB-BP-07-02D	Primary Tailings Pond - grab sample location VB-BP-07 2.25 to 2.5 ft bgs	2,000	29 U	43 U	19 U
VB-BP-07-05	Primary Tailings Pond - grab sample location VB-BP-07 5.5 to 6 ft bgs	1,200	42	40 J	17 U
VB-BP-07-06	Primary Tailings Pond - grab sample location VB-BP-07 6.25 to 6.5 ft bgs	600	48	24 U	16 U
VB-BP-07-09	Primary Tailings Pond - grab sample location VB-BP-07 9.25 to 9.5 ft bgs	2,600	57	52 U	23 U
VB-BP-07-11	Primary Tailings Pond - grab sample location VB-BP-07 11 to 11.25 ft bgs	3,000	43	55 U	24 U
VB-BP-07-13	Primary Tailings Pond - grab sample location VB-BP-07 13.5 to 13.6 ft bgs	970	41	29 U	16 U
VB-BP-07-14	Primary Tailings Pond - grab sample location VB-BP-14 14 ft bgs	2,900	64	55U	24 U
VB-BP-07-15	Primary Tailings Pond - grab sample location VB-BP-07 15 to 17 ft bgs	2,200	37 U	94	24 U
VB-BP-14-01	Primary Tailings Pond - grab sample location VB-BP-14 1.75 to 2 ft bgs	1,800	34 U	42 U	18 U
VB-BP-14-08	Primary Tailings Pond - grab sample location VB-BP-14 8 to 8.25 ft bgs	6,000	95	85 U	30 U
VB-BP-14-11	Primary Tailings Pond - grab sample location VB-BP-14 11 to 11.25 ft bgs	2,300	34 U	47 U	21 U
VB-BP-14-13	Primary Tailings Pond - grab sample location VB-BP-14 13.75 to 14 ft bgs	9,400	46 U	120 U	41 U
VB-BP-14-21	Primary Tailings Pond - grab sample location VB-BP-14 21 to 21.5 ft bgs	1,700	37	40 U	19 U
VB-BP-14-38	Primary Tailings Pond - grab sample location VB-BP-14 38 to 38.5 ft bgs	2,800	110	58 U	25 U
VB-BP-14-42	Primary Tailings Pond - grab sample location VB-BP-14 42 ft bgs	67	23 U	14 J	14 U
VB-BP-16-03	Primary Tailings Pond - grab sample location VB-BP-16 3.5 to 4 ft bgs	2,100	26 U	43 U	19 U
VB-BP-16-16	Primary Tailings Pond - grab sample location VB-BP-16 ft bgs	4,300	37 U	68 U	27 U

**TABLE 1**  
**Source Samples XRF Analytical Results**  
**(Concentrations in parts per million (ppm))**  
**(continued)**

Sample ID	Sample Location	Pb	U	As	Hg
	SCDM RDSC Benchmark	-	-	23	23
	SCDM CRSC Benchmark	-	-	0.43	-
	RBC Industrial Benchmarks (Pb is from EPA Lead Sites Workgroup)	800	200 N	1.9 C	-
VB-BP-16-19	Primary Tailings Pond - grab sample location VB-BP-16 19.5 to 20 ft bgs	910	36 U	30 U	20 U
VB-BP-16-23	Primary Tailings Pond - grab sample location VB-BP-16 23.5 to 24 ft bgs	1,100	90	36 U	22 U
VB-BP-16-30	Primary Tailings Pond - grab sample location VB-BP-16 30 to 31 ft bgs	2,200	60	51 U	23 U
VB-BP-17-07	Primary Tailings Pond - grab sample location VB-BP-17 7 to 7.5 ft bgs	900	28 U	31 U	22 J
VB-BP-17-09	Primary Tailings Pond - grab sample location VB-BP-17 9 to 9.5 ft bgs	1,100	28 U	34 U	20 U
VB-BP-17-12	Primary Tailings Pond - grab sample location VB-BP-17 12 to 12.5 ft bgs	1,600	26 U	38 U	18 U
VB-BP-17-20	Primary Tailings Pond - grab sample location VB-BP-17 20 to 20.5 ft bgs	3,200	34	56 U	22 U
VB-BP-17-24	Primary Tailings Pond - grab sample location VB-BP-17 24 ft bgs	29	23 U	13 U	14 U
VB-BP-20-04	Primary Tailings Pond - grab sample location VB-BP-20 4 to 4.5 ft bgs	4,000	36 U	65 U	24 U
VB-BP-20-18	Primary Tailings Pond - grab sample location VB-BP-20 18 to 18.5 ft bgs	4,100	45	66 U	24 U
VB-BP-20-32	Primary Tailings Pond - grab sample location VB-BP-20 32.5 to 38 ft bgs	710	32 U	25 U	15 U
VB-BP-30-03	Primary Tailings Pond - grab sample location VB-BP-30 3.5 to 5.5 ft bgs	2,400	33 U	47 U	20 U
VB-BP-30-06X	Primary Tailings Pond - grab sample location VB-BP-30 6.5 to 7 ft bgs	5,500	35 U	76 U	28 U
VB-BP-30-10	Primary Tailings Pond - grab sample location VB-BP-30 10 to 18 ft bgs	2,300	37 U	51 U	23 U
VB-BP-30-18	Primary Tailings Pond - grab sample location VB-BP-30 18 to 24 ft bgs	28 J	22 U	13 U	14 U
VB-BP-30-24	Primary Tailings Pond - grab sample location VB-BP-30 24 to 25 ft bgs	820	25 U	29 U	16 U
VB-BP-30-25	Primary Tailings Pond - grab sample location VB-BP-30 25.5 to 27 ft bgs	23 J	22 U	13 U	14 U
VB-BP-30-25D	Primary Tailings Pond - grab sample location VB-BP-30 25.5 to 27 ft bgs	44 J	21 U	13 U	14 U
VB-BP-MD-01	Primary Tailings Pond - composite sample 2 ft bgs to depth	2,500	34 U	50 U	22 U
VB-BP-MD-02	Primary Tailings Pond - composite sample 2 ft bgs to depth	3,000	34 U	56 U	24 U
VB-BP-MD-03	Primary Tailings Pond - composite sample 2 ft bgs to depth	2,300	34 U	49 U	22 U
VB-BS-32-05	Secondary Tailings Pond - grab sample location VB-BS-32 5 to 5.5 ft bgs	33 J	22 U	13 U	14 U
VB-BS-33-08	Secondary Tailings Pond - grab sample location VB-BS-33 8 to 8.5 ft bgs	23 J	22 U	13 U	14 U
VB-BS-34-02	Secondary Tailings Pond - grab sample location VB-BS-34 2 to 2.5 ft bgs	18 J	20 U	13 U	14 U

**TABLE 1**  
**Source Samples XRF Analytical Results**  
**(Concentrations in parts per million (ppm))**  
**(continued)**

Sample ID	Sample Location	Pb	U	As	Hg
	<b>SCDM RDSC Benchmark</b>	-	-	23	23
	<b>SCDM CRSC Benchmark</b>	-	-	0.43	-
	<b>RBC Industrial Benchmarks (Pb is from EPA Lead Sites Workgroup)</b>	800	200 N	1.9 C	-
VB-BS-36-07	Secondary Tailings Pond - grab sample location VB-BS-36 7 to 7.5 ft bgs	17 U	22 U	13 U	14 U
VB-BS-38-05	Secondary Tailings Pond - grab sample location VB-BS-38 5 to 5.5 ft bgs	13*	34 U	44 U	18 U
VB-BS-38-10	Secondary Tailings Pond - grab sample location VB-BS-38 10 to 10.5 ft bgs	18 J	21 U	13 U	14 U
VB-BS-38-10D	Secondary Tailings Pond - grab sample location VB-BS-38 10 to 10.5 ft bgs	18 J	21 U	13 U	14 U
VB-BS-39-08	Secondary Tailings Pond - grab sample location VB-BS-39 8 to 8.5 ft bgs	22 J	20 U	13 U	14 U
VB-BS-MD-01	Secondary Tailings Pond - composite sample 2 ft bgs to depth	180	24 U	15 U	14 U
VB-BS-MD-02	Secondary Tailings Pond - composite sample 2 ft bgs to depth	190	24 U	15 U	14 U
VB-BS-MD-03	Secondary Tailings Pond - composite sample 2 ft bgs to depth	180	23 U	14 U	14 U
VB-DP-01-05	Primary Tailings Pond Dike Dam - grab sample location VB-DP-01 5.5 to 6.5 ft bgs	8,372	N/A	N/A	35U
VB-DP-01-09	Primary Tailings Pond Dike Dam - grab sample location VB-DP-01 9.5 to 10.5 ft bgs	6,200	36 U	110	31 U
VB-DP-01-22	Primary Tailings Pond Dike Dam - grab sample location VB-DP-01 22 to 23 ft bgs	10,000	49 U	200	54 U
VB-DP-01-24	Primary Tailings Pond Dike Dam - grab sample location VB-DP-01 24 to 25 ft bgs	2,500	31 U	51 U	22 U
VB-DP-01-26	Primary Tailings Pond Dike Dam - grab sample location VB-DP-01 26 to 27 ft bgs	130	20 U	13 U	14 U
VB-DP-MD-01	Primary Tailings Pond Dike Dam - composite sample 2 ft bgs to depth	3,000	39	59 U	26 U
VB-DP-MD-02	Primary Tailings Pond Dike Dam - composite sample 2 ft bgs to depth	2,800	40	55 U	21 U
VB-DP-MD-03	Primary Tailings Pond Dike Dam - composite sample 2 ft bgs to depth	2,900	35 U	73	24 U

J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable.

U The substance was not detected at or above the reported concentration. Pb Lead U Uranium As Arsenic Hg Mercury

XRF X-Ray Fluorescence

RDSC Reference Dose Screening Concentration. CRSC Cancer Risk Screening Concentration.

SCDM Superfund Chemical Data Matrix. RBCs Risk-Based Concentrations.

N Non-carcinogenic effects. C Carcinogenic effects.

\* VB-BD-MO-01 results of 1,800 ppm and VB-BS-38-05 results of 2,100 results initially reported are in error.

\*\* Uranium results from Severn Trent Laboratory using method 6020.

Sources: EPA 2004b (SCDM); EPA 2004a (RBCs); EPA 2004g

**TABLE 2**  
**Soil Cover Samples Radiological Analytical Results**  
**(Concentrations in Picocuries per gram (pCi/g))**

		Radium 226	Radium 228	Gross Alpha	Gross Beta
Sample ID	Location	Result ± TPU	Result ± TPU	Result ± TPU	Result ± TPU
EPA Remediation Goal (Composite 0 - 15 cm bgs)		5*			
VB-BD-RS	Disposal pit	2 U	4 U	6.56 ± 2.64 J	24.1 ± 10.3
VB-BP-RS	Primary tailings pond	2 U	3.66 ± 2.07 J	11.1 ± 2.77	22.9 ± 5.96
VB-BS-RS	Secondary tailings pond	2.73 ± 0.615	4.2 ± 2.26	38.1 ± 4.82	41.8 ± 4.51
EPA Remediation Goal (Composite 15 - 30 cm bgs)		15*			
VB-BD-RD	Disposal pit	2 U	3.95 ± 2.14 J	11.7 ± 2.35	19.6 ± 5.63
VB-BP-RD	Primary tailings pond	2 U	4 U	13.7 ± 2.76	25 ± 6.42
VB-BS-RD	Secondary tailings pond	2.86 ± 0.638	4 U	39.4 ± 4.71	43.1 ± 5.03

U The substance was not detected at or above the reported concentration.  
 J The associated numeric value is estimated because quality control criteria were not met. Presence of the substance is reliable.  
 \* The remediation goal is for residential soil only and is presented here for screening purposes.  
 TPU Total Propagated Uncertainty.  
 cm Centimeters.  
 bgs Below ground surface.

Source: (EPA 1998)

**TABLE 3**  
**Source Samples SPLP Analytical Results**  
**Concentrations in mg/L or Pci/L**

<b>Sample ID:</b>	<b>TCLP</b>	<b>VB-BP-MD</b>	<b>VB-BS-MD</b>	<b>VB-BD-MD</b>	<b>VB-DP-01</b>
<b>Location:</b>		<b>Primary Tailings Pond</b>	<b>Secondary Tailings Pond</b>	<b>Disposal Pit</b>	<b>Primary Pond Dike Dam</b>
<b>Analyte (Abbrev)</b>	<b>mg/L</b>	<b>mg/L</b>	<b>mg/L</b>	<b>mg/L</b>	<b>mg/L</b>
Arsenic (As)	5.0	0.0034 U	0.0034 U	0.0034 U	0.0048 J
Barium (Ba)	100.0	0.15 J	0.029 J	0.026 J	0.0078 J
Cadmium (Cd)	1.0	0.00049 J	0.00038 U	0.00038 U	0.23
Chromium (Cr)	5.0	0.0012 J	0.0012 U	0.0012 U	0.0069 J
Lead (Pb)	5.0	0.0030 J	0.0015 U	0.0015 U	3.0
Mercury (Hg)	0.2	0.000025 U	0.000025 U	0.000025 U	0.000025 U
Nickel (Ni)	1.0	0.0020 U	0.0020 U	0.0020 U	0.085 J
Selenium (Se)	1.0	0.0033 U	0.0033 U	0.0038 U	0.0033 U
Silver (Ag)	5.0	0.00080 U	0.00080 U	0.10 U	0.00037 U
		<b>pCi/L</b>	<b>pCi/L</b>	<b>pCi/L</b>	<b>pCi/L</b>
Radium 226	NA	2.39 ± 0.371	1 U	1 U	2.12 ± 0.36
Radium 228	NA	1.49 ± 0.628	1.4 U	1.4 U	3.24 ± 0.649
Gross Alpha	NA	23.5 ± 1.98	23.8 ± 1.68	3.66 ± 0.831	1030 ± 64.9
Gross Beta	NA	8.81 ± 0.941	2.76 ± 1.44 J	2.23 ± 0.102 J	208 ± 16.2

J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable.  
 U The analyte was not detected at or above the Contract Required Detection Limit (CRDL).  
 TCLP Toxicity Characteristic Leaching Procedure. SPLP Synthetic Precipitation Leachate Procedure.  
 mg/L Milligrams per liter. pCi/L Picocuries per liter.  
 NA TCLP does not include limits for radiological substances.

Source: (EPA 1996 (SPLP); Office of Federal Register 1993)

**TABLE 4**  
**Surface Soil Samples XRF Analytical Results**  
**(Concentrations in parts per million (ppm))**

Sample ID	Interval	Sample Location	Pb	U	As	Hg
		SCDM RDSC Benchmark	-	-	23	23
		SCDM CRSC Benchmark	-	-	0.43	-
		Industrial RBC (Pb is from EPA Lead Sites Workgroup)	800	200 N	1.9 C	-
		Residential Pb is from EPA Residential Soil Handbook	400			
HMS-11	4" - 8"	Xcel fly ash	62	22 U	13 U	16 U
HMS-11D	4" - 8"	Xcel fly ash	53 J	22 U	16 J	16 U
VB-SL-02		Drum contents - Haz Class drum 16 in the used parts area (Photo #14 in Appendix D)	13,000	34 U	330	57 U
VB-SL-05		Drum contents - Haz Class drum #24 west of 3-bay garage (Photo #17 in Appendix D)	5,900	36 U	610	43 U
VB-SL-07		Drum contents - Corroded, behind rust-colored drum (Photo #17 in Appendix D)	380	40 U	31 U	41 U
VB-SL-09		Drum contents - Haz Class drum #11 northeast of ASTs (Photo #10 in Appendix D)	11,000	30 U	430	48 U
VB-SL-13		Drum contents - Haz Class corroded drums behind empty corrugated shed east of wood shop.	76	24 U	13 U	14 U
VB-SL-14		Drum contents - south of three-bay garage (Photo 3 Appendix B)	150	23 U	14 U	15 U
VB-SG-01	0 -1"	Background - Fence	110	23 U	13 U	14 U
VB-SG-02	0 -1"	Background - Fence	290	25 U	17 U	14 U
VB-SG-03	0 -1"	Background - Fence	500	25 U	23 U	15 U
VB-SG-04	0 -1"	Background - Fence	400	24 U	20 U	14 U
VB-SG-05	0 -1"	Background - Fence	210	24 U	15 U	14 U
VB-SL-15	0 -1"	Background - Valmont Butte (Photo 20 Appendix B)	84	25 U	13 U	16 U
VB-SL-20	0 -1"	Background - Valmont Butte	74	24 U	13 U	14 U
VB-SL-21	0 -1"	Background - Valmont Butte (Photo 1 Appendix B)	56 J	24 U	13 U	15 U
VB-SL-17	0-2"	Area 1 - Composite from core of north side of primary pond dike dam (Photo 17 Appendix B)	5,400	34 U	200	30 U
VB-SL-18	0-1"	Area 1 - North of primary pond dike dam (Photo 17 Appendix B)	1,600	25 U	68	18 U
VB-SL-35	0-1"	Area 1 - North of primary pond dike dam - composite across length of dam (Photo 17 Appendix B)	3,400	33 U	68	25 U
Delta-7	0-1"	Area 1 - North of primary pond dike dam	1,900	28**	70	20 U

**TABLE 4**  
**Surface Soil Samples XRF Analytical Results**  
**(Concentrations in parts per million (ppm))**  
**(continued)**

Sample ID	Interval	Sample Location	Pb	U	As	Hg
		SCDM RDSC Benchmark	-	-	23	23
		SCDM CRSC Benchmark	-	-	0.43	-
		Industrial RBC (Pb is from EPA Lead Sites Workgroup)	800	200 N	1.9 C	-
		Residential Pb is EPA Residential Soil Handbook	400			
VB-SL-25	0-1"	Area 2 - along previous location of old slurry line	310	24 U	18 U	14 U
VB-SU-11	0-1"	Area 3 - Around tree stump in front of wood shop	2,100	82	70 U	620
VB-SU-12	0-1"	Area 3 - In front of wood shop	480	23 U	22 U	15 U
VB-SU-12D	0-1"	Area 3 - In front of wood shop	530	24 U	25 J	16 U
Delta-9	0-1"	Area 3 - In front of wood shop	1,200	35**	46 U	180
Delta-9D	0-1"	Area 3 - In front of wood shop	1,200	NA	48 U	190
VB-SL-26	0-1"	Area 4 - East side of mill	2,000	85	52 U	24 U
VB-SU-13	0-1"	Area 5 - Ore storage area	460	35	22 U	15 U
VB-SL-01	0-1"	Site - Used parts area described in Haz Class report (Photo 14 Appendix D)	500	23 U	23 U	15 U
VB-SL-03	0-1"	Site - Under 6 empty drums near cement block paint locker building	640	23 U	24 U	14 U
VB-SL-04	0-1"	Site - In front of three-bay garage (Photo 16 Appendix D)	1,900	27 U	220	25 U
VB-SL-06	0-1"	Site - West of three-bay garage (Photo 17 Appendix D)	4,400	27 U	140	30 U
VB-SL-08	0-1"	Site - Under three ASTs west of mill (Photo 12 Appendix D)	440	22 U	21 U	14 U
VB-SL-10	0-1"	Site - Areas north and east of ASTs and south of mill (Photos 9-12 Appendix D)	1,300	23 U	110	19 U
VB-SL-10D	0-1"	Site - Areas north and east of ASTs and south of mill	1,400	24 U	93	21 U
VB-SL-11	0-1"	Site - Floor of corrugated shed east of mill (Photo 18 Appendix D)	1,400	24 U	39 J	17 U
VB-SL-40	0-1"	Site - Area north of HazClass drum #12 outside mill window on west side (Photo 11 Appendix D)	2,700	30 U	110	27 U
VB-SL-16	0-12"	Site - Under 6 empty drums near cement block paint locker building	25 J	22 U	13 U	14 U
VB-SL-19	0-1"	Site - Burlap bag site north of primary pond dam	54 J	21 U	13 U	14 U
VB-SL-22	0-6"	Site - Under white drum located west of sample location VB-BP-01	350	21 U	17 U	14 U

**TABLE 4**  
**Surface Soil Samples XRF Analytical Results**  
**(Concentrations in parts per million (ppm))**  
**(continued)**

Sample ID	Interval	Sample Location	Pb	U	As	Hg
		SCDM RDSC Benchmark	-	-	23	23
		SCDM CRSC Benchmark	-	-	0.43	-
		Industrial RBC (Pb is from EPA Lead Sites Workgroup)	800	200 N	1.9 C	-
		Residential Pb is EPA Residential Soil Handbook	400			
VB-SL-22D	0-6"	Site - Under white drum located west of sample location VB-BP-01	460	21 U	20 U	14 U
VB-SL-23	0-1"	Site - Railroad bed	300	22 U	17 U	14 U
VB-SL-24	0-1"	Site - East of railroad bed in area devoid of vegetation	4,500	29 U	72 U	26 U
VB-SL-27	0-1"	Site - Under white drum located west of sample location VB-BP-01	640	28 U	28 U	18 U
VB-SL-28	0-1"	Site - East end of primary dike dam in gap between dam and dike	440	24 U	25 J	15 U
VB-SL-29	0-10"	Site - North of western dike dam in secondary tailings pond	2,100	28 U	170	22 U
VB-SL-30	0-7"	Site - North of eastern dike dam in secondary tailings pond	1,000	27 U	39 J	18 U
VB-SL-31	0-4"	Site - Composite of core immediately north of western dike dam in secondary pond	110	24 U	13 U	14 U
VB-SL-32	0-6"	Site - North of eastern dike dam in secondary tailings pond	110	22 U	13 U	14 U
VB-SL-33	0-1"	Site - Composite of core east of secondary pond and northeast of road around pond	250	24 U	16 U	14 U
VB-SL-34	0-1"	Site - Composite from core from debris pile east of secondary pond	210	24 U	16 J	14 U
VB-SL-36	0-1"	Site - North of western dike dam in secondary tailings pond - composite along length of dam	1,000	26 U	43 J	17 U
VB-SL-37	0-1"	Site - North of eastern dike dam in secondary tailings pond - composite along length of dam	490	24 U	22 U	15 U
VB-SL-37D	0-1"	Site - North of eastern dike dam in secondary tailings pond - composite along length of dam	520	25 U	22 U	14 U
VB-SL-38	0-1"	Site - Northeast of secondary pond	500	26 U	29 J	15 U
VB-SL-39	0-1"	Site - Debris pile east of secondary pond	290	24 U	18 U	15 U
VB-SO-01	0-1"	Site - Borrow pit east and west of western dike dam in secondary pond	470	24 U	28 J	16 U
VB-SO-02	0-1"	Site - North of western dike dam in secondary tailings pond	1,400	27 U	36 U	19 U
VB-SO-03	0-1"	Site - Borrow pit located on south side of primary pond	49 J	21 U	13 U	14 U
VB-NA-01	0-1"	Sweat Lodge - First 30-point composite	65	NA	45	20 U

**TABLE 4**  
**Surface Soil Samples XRF Analytical Results**  
**(Concentrations in parts per million (ppm))**  
**(continued)**

Sample ID	Interval	Sample Location	Pb	U	As	Hg
		SCDM RDSC Benchmark	-	-	23	23
		SCDM CRSC Benchmark	-	-	0.43	-
		Industrial RBC (Pb is from EPA Lead Sites Workgroup)	800	200 N	1.9 C	-
		Residential Pb is EPA Residential Soil Handbook	400			
VB-NA-01R	0-1"	Sweat Lodge - First 30-point composite	59 J	NA	34	20 U
VB-NA-02	0-1"	Sweat Lodge - First 30-point composite	53 J	NA	32 J	20 U
VB-NA-02R	0-1"	Sweat Lodge - First 30-point composite	70	NA	30 J	20 U
VB-NA-03	0-1"	Sweat Lodge - First 30-point composite	46 J	NA	23 J	20 U
VB-NA-03R	0-1"	Sweat Lodge - First 30-point composite	68	NA	31 J	20 U
VB-NA-04	0-1"	Sweat Lodge - Second 30-point composite	51 J	NA	33 J	20 U
VB-NA-04R	0-1"	Sweat Lodge - Second 30-point composite	71	NA	37	20 U
VB-NA-05	0-1"	Sweat Lodge - Second 30-point composite	60 J	NA	25 J	20 U
VB-NA-05R	0-1"	Sweat Lodge - Second 30-point composite	72	NA	39	20 U
VB-NA-06	0-1"	Sweat Lodge - Second 30-point composite	53 J	NA	33 J	20 U
VB-NA-06R	0-1"	Sweat Lodge - Second 30-point composite	64	NA	42	20 U
VB-NA-07	0-1"	Sweat Lodge -Third 30-point composite	54 J	NA	29 J	20 U
VB-NA-07R	0-1"	Sweat Lodge -Third 30-point composite	64	NA	38	20 U
VB-NA-08	0-1"	Sweat Lodge -Third 30-point composite	63 J	NA	25 J	20 U
VB-NA-08R	0-1"	Sweat Lodge -Third 30-point composite	63 J	NA	34	20 U
VB-NA-09	0-1"	Sweat Lodge -Third 30-point composite	53 J	NA	33 J	20 U
VB-NA-09R	0-1"	Sweat Lodge -Third 30-point composite	58 J	NA	36	20 U
VB-SU-01	0-1"	Surface water drainage pathway southwest corner of site	460	23 U	21 U	15 U
VB-SU-02	0-1"	Surface water drainage pathway from wetlands at northeast corner of site	110	24 U	13 U	14 U
VB-SU-03	0-1"	Surface water drainage ditch north of western dike dam in secondary pond	200	23 U	15 U	14 U

**TABLE 4**  
**Surface Soil Samples XRF Analytical Results**  
**(Concentrations in parts per million (ppm))**  
**(continued)**

Sample ID	Interval	Sample Location	Pb	U	As	Hg
		SCDM RDSC Benchmark	-	-	23	23
		SCDM CRSC Benchmark	-	-	0.43	-
		Industrial RBC (Pb is from EPA Lead Sites Workgroup)	800	200 N	1.9 C	-
		Residential Pb is EPA Residential Soil Handbook	400			
VB-SU-04	0-1"	Surface water drainage ditch north of primary pond dike dam	90	23 U	13 U	14 U
VB-SU-05	0-1"	Residential - 6717 Valmont Road - Khalsa yard from both yard on both sides of driveway	80	23 U	13 U	14 U
VB-SU-06	0-1"	Residential - 6423 Valmont Road - Southeast corner of Bob Keeter residential property	82	23 U	13 U	14 U
VB-SU-07	0-1"	Residential - 6379 Valmont Road - Around two silos	84	23 U	13 U	14 U
VB-SU-08	0-1"	Residential - 6379 Valmont Road - Joy and Harley Keeter residential property	200	23 U	15 U	14 U
VB-SU-09	0-1"	Residential - 6363 Valmont Road - Keeter driveway	84	23 U	13 U	14 U
VB-SU-10	0-1"	Residential - 6327 Valmont Road - Botteril yard	110	23 U	13 U	14 U

J The associated numeric value is estimated because quality control criteria were not met. Presence of the substance is reliable.  
 U The substance was not detected at or above the reported concentration.  
 C Carcinogenic effects N Noncarcinogenic effects PRGs EPA Region 9 Primary Remediation Goals  
 Pb Lead U Uranium As Arsenic Hg Mercury  
 XRF X-ray fluorescence  
 RDSC Reference Dose Screening Concentration. CRSC Cancer Risk Screening Concentration.  
 SCDM Superfund Chemical Data Matrix. RBCs Risk-Based Concentrations.  
 C Carcinogenic effects.  
 NA Analyses not included  
 R Sample cup was analyzed a second time.

Source: EPA 2004b (SCDM); EPA 2004a (Region 3 RBCs); EPA 2004g (Lead Sites Workgroup); EPA 2003 (Residential Soil Handbook).

TABLE 5  
Surface Soil Samples Semivolatile Organic Compounds Analytical Results  
Concentrations in µg/kg (ppb)

Sample ID#: Lab Sample ID: Location:	SCDM Soil Pathway		Region 3 RBCs (04/2004)	VB-SL-01 H17M7 Used parts area	VB-SL-03 H17M8 Under six drums (0 to 1")	VB-SL-04 H17M9 Front of 3-bay garage	VB-SL-06 H17N0 West of 3-bay garage	VB-SL-08 H17N1 Under ASTs	VB-SL-11 H17N2 Floor of corrugated shed	VB-SL-12 H17R5 Under leaking cabinet in used parts area	VB-SL-16 H17R8 Under six drums (0 to 12")	VB-SL-22 H17R9 Under white drum
	RDSC	CRSC	Industrial Soil									
Benzaldehyde			100,000,000 N	310 J	360 U	350 U	370 U	400 U	160,000 U	92,000 U	370 U	12,000 U
Acetophenone	7,800,000		100,000,000 N	60 J	360 U	350 U	140 J	400 U	160,000 U	92,000 U	370 U	12,000 U
Naphthalene	3,100,000		20,000,000 N	390 U	360 U	120 J	450	400 U	160,000 U	92,000 U	370 U	12,000 U
Caprolactam			510,000,000 N	390 U	360 U	50 J	370 U	400 U	160,000 U	92,000 U	370 U	12,000 U
2-Methylnaphthalene			4,100,000 N	390 U	360 U	200 J	840	400 U	160,000 U	92,000 U	370 U	12,000 U
1,1'-biphenyl	3,900,000		51,000,000 N	390 U	360 U	350 U	40 J	400 U	160,000 U	92,000 U	370 U	12,000 U
Dibenzofuran	310,000		2,000,000 N	390 U	360 U	59 J	230 J	400 U	160,000 U	92,000 U	370 U	12,000 U
Diethylphthalate	63,000,000		820,000,000 N	65 J	360 U	350 U	370 U	400 U	160,000 U	92,000 U	370 U	12,000 U
Phenanthrene				390 U	360 U	140 J	430	400 U	160,000 U	92,000 U	370 U	12,000 U
Anthracene	23,000,000		310,000,000 N	390 U	360 U	350 U	63 J	400 U	160,000 U	92,000 U	370 U	12,000 U
Di-n-butylphthalate	7,800,000		100,000,000 N	390 U	360 U	350 U	70 J	400 U	160,000 U	92,000 U	370 U	12,000 U
Fluoranthene	3,100,000		41,000,000 N	390 U	360 U	170 J	270 J	400 U	160,000 U	92,000 U	370 U	12,000 U
Pyrene	2,300,000		31,000,000 N	390 U	360 U	160 J	280 J	400 U	160,000 U	92,000 U	370 U	12,000 U
Butylbenzylphthalate	16,000,000		200,000,000 N	390 U	360 U	36 J	370 U	400 U	160,000 U	92,000 U	370 U	12,000 U
Benzo(a)anthracene		880	3,900 C	390 U	360 U	53 J	100 J	400 U	160,000 U	92,000 U	370 U	12,000 U
Chrysene		88,000	390,000 C	67 J	360 U	110 J	200 J	400 U	160,000 U	92,000 U	370 U	12,000 U
Bis(2-ethylhexyl)phthalate	1,600,000	46,000	200,000 C	600	370	290 J	710	790	180,000 U	92,000 U	130 J	17,000
Benzo(b)fluoranthene		880	3,900 C	46 J	360 U	69 J	120 J	400 U	160,000 U	92,000 U	370 U	12,000 U
Benzo(k)fluoranthene		8,800	39,000 C	40 J	360 U	47 J	65 J	400 U	160,000 U	92,000 U	370 U	12,000 U
Benzo(a)pyrene		88	390 C	390 U	360 U	37 J	57 J	400 U	160,000 U	92,000 U	370 U	12,000 U
Indeno(1,2,3-cd)-pyrene		880	3,900 C	390 U	360 U	40 J	38 J	400 U	160,000 U	92,000 U	370 U	12,000 U
Benzo(g,h,i)perylene				390 U	360 U	37 J	370 U	400 U	160,000 U	92,000 U	370 U	12,000 U
Number of Tentatively Identified Compounds (TICs)				30	9	28	26	14	2	10	22	28

JThe associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the analyte is reliable.

UThe analyte was not detected above the Contract Required Quantitation Limit (CRQL).

CCarcinogenic effects

NNoncarcinogenic effects

Lower than EPA Contract Laboratory Program (CLP) standard detection limits.

SCDMSuperfund Chemical Data Matrix

RDSCReference Dose Screening Concentrations.

CRSCCancer Risk Screening Concentrations

Sources: EPA 2004b (SCDM); EPA 2004a (Region 3 RBCs).

TABLE 6  
Surface Water Samples Total Inorganic Analytical Results  
(Concentrations in micrograms per liter (µg/L) (ppb))

Sample ID: Lab Sample ID: Location:  Analyte (Abbrev)	SCDM Drinking Water			SCDM Environmental Fresh Water		Region 3 RBCs for tap water (04/2004)	VB-SW-01 MH17H9 Butte Mill Ditch (Background)	VB-SW-10 MH17K7 Butte Mill Ditch at Keeter Silos	VB-SW-02 MH17J1 Butte Mill Ditch	VB-SW-03 MH17J3 Butte Mill Ditch	VB-SW-04 MH17J5 S. Boulder Creek (Background)	VB-SW-05 MH17J7 S. Boulder Creek	VB-SW-09 MH17K5 Rogers Pond (Background)	VB-SW-07 MH17K1 Boulder Ready Mix Concrete Pond	VB-SW-06 MH17J9 Keeter Pond	VB-SW-08 MH17K3 On-site Wetlands
	MCL/ MCLG	RDSC	CRSC	Acute	Chronic											
Antimony (Sb)	6.0	15				15 N	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Arsenic (As)	10	11	0.057	190	190	0.045 C	1.0U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.7	1.0 U	1.5	1.5
Barium (Ba)	2,000	2,600				2,600 N	94.2	74.4	75.7	76.6	94.6	89.5	94.0	47.2	74.3 J	83.3
Beryllium (Be)	4.0	73	--			73 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Cadmium (Cd)	5.0	18		1.1	1.1	18 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chromium (Cr)	100	110		11	11		2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Cobalt (Co)						730 N	1.0 U	0.13 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.2
Copper (Cu)	1,300			12	12	1,500 N	2.4	1.9 J	2.2	1.8 J	2.0	1.8 J	0.62 J	1.2 J	2.1	2.1
Lead (Pb)	15			3.2	3.2		2.0	1.3	2.1	1.2	1.4	1.1	0.51 J	0.31 J	0.92 J	2.6
Manganese (Mn)		5,100				730 N	24.4	18.2	17.6	17.4	19.4	19.7	98.0	25.3	82.5	1,040
Mercury (Hg)	2.0	11		0.012	0.012	-	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Nickel (Ni)		730		160	160	730 N	1.4	1.3	1.4	1.3	1.1	1.2	1.1	1.6	1.5 J	4.9
Selenium (Se)	50	180		5.0	5.0	180 N	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Silver (Ag)		180		4.1	4.1	180 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U
Thallium (Tl)	0.50					2.6 N	0.10 J	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 UJ	1.0 U
Vanadium (V)		260				37 N	1.8	1.9	1.8	1.7	1.2	1.2	1.2	1.6	2.2	1.6
Zinc (Zn)		11,000		110	110	11,000 N	8.5	4.9	13.4	5.5	4.2	3.1	2.3	3.3	7.5	5.5
Uranium	30					7.3 N	30 UJ	30 UJ	30 UJ	30 UJ	30 UJ	30 UJ	30 UJ	30 UJ	30 UJ	30 UJ

J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable.  
U The analyte was not detected at or above the Contract Required Detection Limit (CRDL).  
Lower than Contract Laboratory Program (CLP) standard detection limits.  
The concentration detected is greater than one or more benchmarks.  
MCL/MCLG Maximum Contaminant Level/Maximum Contaminant Level Goal.  
RDSC Reference Dose Screening Concentration.  
CRSC Cancer Risk Screening Concentration.  
SCDM Superfund Chemical Data Matrix.  
RBCs Region 3 Risk-Based Concentrations.  
N Non-carcinogenic effects.  
C Carcinogenic effects.

Sources: EPA 2004b (SCDM); EPA 2004a (Region 3 RBCs).

TABLE 7  
Surface Water Samples Dissolved Inorganic Analytical Results  
Concentrations in micrograms per liter (µg/L (ppb))

Sample ID: Lab Sample ID: Location:  Analyte (Abbrev)	SCDM Drinking Water			SCDM Environmental Fresh Water		Region 3 RBCs for tap water (04/2004)	VB-SW-01D MH17J0 Butte Mill Ditch (Background)	VB-SW-10D MH17K8 Butte Mill Ditch at Keeter Silos	VB-SW-02D MH17J2 Butte Mill Ditch	VB-SW-03D MH17J4 Butte Mill Ditch	VB-SW-04D MH17J6 S. Boulder Creek (Background)	VB-SW-05D MH17J8 S. Boulder Creek	VB-SW-09D MH17K6 Rogers Pond (Background)	VB-SW-07D MH17K2 Boulder Ready Mix Concrete Pond	VB-SW-06D MH17K0 Keeter Pond	VB-SW-08D MH17K4 On-site Wetlands
	MCL/MCLG	RDSC	CRSC	Acute	Chronic											
Antimony (Sb)	6.0	15				15 N	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Arsenic (As)	10	11	0.057	190	190	0.045 C	0.74 J	1.0 U	1.0 U	1.0 U	0.72 J	1.0 U	1.5	0.51 J	1.2	0.75 J
Barium (Ba)	2,000	2,600				2,600 N	89.2	66.9	70.2	71.8	92.2	85.7	87.7	40.1	61.5	57.6
Beryllium (Be)	4.0	73	--			73 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Cadmium (Cd)	5.0	18		1.1	1.1	18 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chromium (Cr)	100	110		11	11		2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Cobalt (Co)						730 N	0.09 J-	1.0 U	0.08 J-	2.6	0.14 J-	0.10 J-	1.0 U	0.08 J-	0.06 J-	2.3
Copper (Cu)	1,300			12	12	1,500 N	1.8 J	1.3 J	1.5 J	1.3 J+	2.0 J+	1.6 J+	0.56 J	0.76 J+	1.2 J+	1.5 J+
Lead (Pb)	15			3.2	3.2		0.46 J	0.30 J	0.46 J	0.23 J	0.48 J	0.31 J	0.19 J	1.0 U	1.0 U	0.08 J
Manganese (Mn)		5,100				730 N	12.5	3.7	2.7	6.3	11.9	14.0	60.2	1.0 U	7.0	282
Mercury (Hg)	2.0	11		0.012	0.012	-	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Nickel (Ni)		730		160	160	730 N	1.3	1.1	1.2	1.3	1.3	1.5	1.1	1.4	1.4	5.3
Selenium (Se)	50	180		5.0	5.0	180 N	1.0 J	0.47 J	0.70 J	0.47 J	1.1 J	0.94 J	0.37 J	5.0 U	0.72 J	2.5 J
Silver (Ag)		180		4.1	4.1	180 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Thallium (Tl)	0.50					2.6 N	0.21 J	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vanadium (V)		260				37 N	1.3	0.72 J	1.1	1.0 UJ	1.1 UJ	1.0 UJ	1.0 U	1.6 J+	1.5 J+	1.0 UJ
Zinc (Zn)		11,000		110	110	11,000 N	3.9	3.6	3.2	4.1	13.5	3.8	3.6	3.8	3.5	4.4
Uranium (U)	30					7.3 N	30 UJ	30 UJ	30 UJ	30 UJ	30 UJ	30 UJ	30 UJ	30 UJ	30 UJ	30 UJ

J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable. J+ indicates possible high bias; J- indicates possible low bias.  
U The analyte was not detected at or above the Contract Required Detection Limit (CRDL).  
Lower than Contract Laboratory Program (CLP) standard detection limits.  
The concentration detected is greater than one or more benchmarks.  
MCL/MCLG Maximum Contaminant Level/Maximum Contaminant Level Goal.  
RDSC Reference Dose Screening Concentration.  
CRSC Cancer Risk Screening Concentration.  
SCDM Superfund Chemical Data Matrix.  
RBCs EPA Region 3 Risk-Based Concentrations.  
N Non-carcinogenic effects.  
C Carcinogenic effects.

Sources: EPA 2004b (SCDM); EPA 2004a (Region 3 RBCs).

**TABLE 8**  
**Surface Water Samples Radiological Analytical Results**  
**(Concentrations in Picocuries per liter (pCi/L))**

		<b>Radium 226</b>	<b>Radium 228</b>	<b>Ra 226 + Ra 228 †</b>	<b>Gross Alpha</b>	<b>Total Uranium *</b>	<b>Adjusted ††* Gross Alpha</b>	<b>Gross Beta</b>
<b>Sample ID</b>	<b>Location</b>	<b>Result ±TPU</b>	<b>Result ±TPU</b>		<b>Result ± TPU</b>	<b>pCi/L</b>		<b>Result ±TPU</b>
<b>EPA SDWA MCL</b>				<b>5</b>			<b>15</b>	<b>50**</b>
VB-SW-01	Butte Mill Ditch (Background)	1 U	1.4 U	2.4	3 U	0	3	4 U
VB-SW-10	Butte Mill Ditch at Keeter Silos	1 U	1.4 U	2.4	3 U	0	3	4 U
VB-SW-02	Butte Mill Ditch	1 U	1.38 ± 0.819 J	2.38	3 U	0	3	4.79 ± 3.85
VB-SW-03	Butte Mill Ditch	1 U	1.4 U	2.4	3 U	0	3	4 U
VB-SW-04	S. Boulder Creek (Background)	1 U	1.4 U	2.4	1.42 ± 0.711 J	0	1.42	4.73 ± 2.41
VB-SW-05	S. Boulder Creek	1 U	1.4 U	2.4	3 U	0	3	4.39 ± 2.69
VB-SW-09	Rogers Pond (Background)	1 U	1.4 U	2.4	3 U	0	3	3.78 ± 3.66 J
VB-SW-07	Boulder Ready Mix Concrete Pond	1 U	1.4 U	2.4	3 U	0	3	4.3 ± 1.52
VB-SW-06	Keeter Pond	1 U	1.4 U	2.4	3 U	0	3	11.6 ± 11.5
VB-SW-08	On-site Wetlands	1.3 ± 0.257	1.4 U	2.7	6.62 ± 2.57	0	6.62	4 U

U The substance was not detected at or above the reported concentration. EPA SDWA MCL Safe Drinking Water Act Maximum Contaminant Level (EPA 2004b (SCDM))

J The associated numeric value is estimated because quality control criteria were not met. Presence of the substance is reliable.

\*\* The Regulatory benchmark of 50 pCi/L for Gross Beta is for man-made isotopes. Radioactive material at this site are NORMs. This benchmark is used for screening purposes only.

\* Uranium and radon are not included in the Adjusted Gross Alpha; The concentration of uranium has been subtracted from the Gross Alpha result. Total uranium analytical results are in Table 6. All total and dissolved uranium data for surface water were qualified as nondetect based on laboratory QA review; zero is used in the calculation as a conservative estimate.

TPU Total Propagated Uncertainty † For Radium 226 and 228 nondetects, a amount equal to the detection limit is used in the calculation as a conservative estimate.

†† For Gross Alpha nondetects, a amount equal to the detection limit is used in the calculation as a conservative estimate.

TABLE 9  
Surface Water Samples Wet Chemistry Analytical Results  
(Concentrations in milligrams per liter (mg/L))

Sample ID: Lab Sample ID: Location:	VB-SW-01 D4H260343-016 Butte Mill Ditch (Background)	VB-SW-02 D4H260343-017 Butte Mill Ditch	VB-SW-03 D4H260343-018 Butte Mill Ditch	VB-SW-04 D4H260343-019 S. Boulder Creek (Background)	VB-SW-05 D4H260343-020 S. Boulder Creek	VB-SW-06 D4H260343-021 Keeter Pond	VB-SW-07 D4H260343-022 Boulder Ready Mix Concrete Pond	VB-SW-08 D4H260343-023 On-site Wetlands	VB-SW-09 D4H260343-024 Rogers Pond (Background)	VB-SW-10 D4H260343-025 Butte Mill Ditch at Keeter Silos
Analyte										
Bicarbonate Alkalinity	110	100	95	100	140	160	97	300	120	95
Carbonate Alkalinity	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	19	5.0 U	5.0 U	5.0 U	5.0 U
Hydroxide Alkalinity	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Total Alkalinity	110	100	95	100	140	180	97	300	120	95
Chloride	38	34	34	38	38	48	30	61	35	34
Fluoride	0.66 J	0.43 J	0.41 J	0.57 J	0.72 J	1.0	0.56 J	3.7	0.67 J	0.38 J
Nitrate	0.5 U	0.38 J-	0.37 J-	0.5 U	0.29 J-	0.5 U	0.5 U	0.5 U	0.5 U	0.38 J-
Nitrite	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Sulfate	37	29	30	34	45	74	21	360	24	29
Lab Sample ID: Analyte	MH17H9/MH17J0 Total	MH17J1/MH17J2 Total	MH17J3/MH17J4 Total	MH17J5/MH17J6 Total	MH17J7/MH17J8 Total	MH17J9/MH17K0 Total	MH17K1/MH17K2 Total	MH17K3/MH17K4 Total	MH17K5/MH17K6 Total	MH17K7/MH17K8 Total
Calcium	31	31.6	31.5	24.4	36.3 / 38.5	27.4	34.4	78.7	32.9	31.5
Sodium	31.3	24.4	24.4	26	34.4 / 32	69.3	20.8	153	26	22.2
Magnesium	13.3	11.1	11	10.3	15.8 / 17.2	26.6	8.720	54.5	12.1	11
Iron	305	559	470	132	129	489	160	1,380	503	451
Lab Sample ID: Analyte	MH17H9/MH17J0 Dissolved	MH17J1/MH17J2 Dissolved	MH17J3/MH17J4 Dissolved	MH17J5/MH17J6 Dissolved	MH17J7/MH17J8 Dissolved	MH17J9/MH17K0 Dissolved	MH17K1/MH17K2 Dissolved	MH17K3/MH17K4 Dissolved	MH17K5/MH17K6 Dissolved	MH17K7/MH17K8 Dissolved
Calcium	30.5	30.8	28.5	28.8	38.5	26.1	33.1	75.8	33	31.1
Sodium	31.5	24.2	22.9	30.4	32	69.6	21.1	174	29.2	24.7
Magnesium	12.9	10.7	10.1	12.1	17.2	25.6	8.41	51.5	12	10.7
Iron	48.8 J-	141 J-	115 J-	65.5 J-	33.3 J-	100 U	100 U	100 U	146 J-	117 J-

J           The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable. J- indicates possible low bias.  
U           The analyte was not detected at or above the Contract Required Detection Limit (CRDL).

TABLE 10  
Sediment Samples Inorganic Analytical Results  
Concentrations in mg/kg (ppm)

Sample ID: Lab Sample ID: Location: Analyte (Abbrev)	SCDM Soil Pathway		EPA Region 3 RBCs (04/2004)	VB-SE-01 MH17K9 Background Butte Mill Ditch	VB-SE-10 MH17L8 Butte Mill Ditch	VB-SE-02 MH17L0 Butte Mill Ditch	VB-SE-03 MH17L1 Butte Mill Ditch	VB-SE-04 MH17L2 Background S Boulder Creek	VB-SE-05 MH17L3 S Boulder Creek	VB-SE-09 MH17L7 Background Don Rogers Pond	VB-SE-06 MH17L4 Ready Mix Pond	VB-SE-07 MH17L5 Ben Keeter Pond	VB-SE-08* MH17L6 Wetlands
	RDSC	CRSC	Industrial Soil										
Aluminum (Al)			1,000,000 N	5,740	8,510	8,530	9,410	1,710	1,570	2,760	★ 10,100	★ 11,000	18,700
Antimony (Sb)	31		410 N	7.4 UJ	7.8 UJ	8.6 UJ	10.7 UJ	6.3 UJ	6.7 UJ	6.4 UJ	10.1 UJ	8.5 UJ	14.5 UJ
Arsenic (As)	23	0.43	1.9 C	2.9	3.5	3.1	3.8	1.3	1.6	1.9	3.6	3.5	7.3
Barium (Ba)	5,500		72,000 N	71.2 J	140 J	84.3 J	103 J	15.6 J	18.1 J	31.5 J	88.9 J	★ 134 J	558 J
Beryllium (Be)	160		2,000 N	0.62 U	0.65 U	0.72 U	0.89 U	0.52 U	0.56 U	0.53 U	0.84 U	0.71 U	1.2 U
Cadmium (Cd)	39		510 N	0.62 UJ	0.65 UJ	0.72 UJ	0.89 U	0.52 U	0.56 U	0.53 U	0.84 UJ	0.71 UJ	1.2 UJ
Calcium (Ca)				3,220	5,110	4,100	3,780	1,190	1,870	1,140	★ 17,500	★ 10,000	11,300
Chromium (Cr)	230			15.7	19.3	18.5	18.2	4.6	4.6	7.5	18.8	21.5	19.1
Cobalt (Co)			20,000 N	6.2 U	6.5 U	7.2 U	8.9 U	5.2 U	5.6 U	5.4 U	8.4 U	7.8	15.4
Copper (Cu)			41,000 N	16.6	19.2	19.2	24.6	4.6	5.6	6.8	★ 23.8	★ 21.3	41.8
Iron (Fe)			310,000 N	13,000	17,000	16,000	15,600	3,960	3,990	4,490	★ 18,300	★ 17,200	28,000
Lead (Pb)			800 **	24.8	36.8	28.6	35.5	6.0	5.9	8.8	18.9	17.1	79.8
Magnesium (Mg)				3,140	3,600	3,790	4,140	789	776	1,280	★ 8,250	★ 4,870	6,640
Manganese (Mn)	11,000		20,000 N	140 J	241 J	169 J	237 J	38.7 J	43.8 J	41.7 J	★ 221 J	★ 212 J	4,190 J
Mercury (Hg)	23			0.15	0.13 U	0.14 U	0.21	0.10 U	0.11 U	0.11 U	0.17 U	0.14 U	0.26 U
Nickel (Ni)	1,600		20,000 N	11.5	11.6	12.2	14.0	2.8 J	2.9 J	4.6	★ 14.5	★ 18.0	17.4
Potassium (K)				1,830	2410	2,470	2,740	549	456 J	879	2,340	★ 3,270	2,350
Selenium (Se)	390		5,100 N	4.3 UJ	4.5 UJ	5.0 UJ	6.2 UJ	3.7 UJ	3.9 UJ	3.7 UJ	5.9 UJ	5.0 UJ	8.4 UJ
Silver (Ag)	390		5,100 N	1.2 UJ	1.3 UJ	1.4 UJ	1.8 UJ	1.0 UJ	1.1 UJ	1.1 UJ	1.7 UJ	1.4 UJ	2.4 UJ
Sodium (Na)				82.6 J	153 J	110 J	112 J-	43.3 J-	56.8 J-	42.8 J-	★ 336 J	117 J	4,320
Thallium (Tl)			72 N	3.1 U	3.2 U	3.6 U	4.5 U	2.6 U	2.8 U	2.7 U	4.2 U	3.6 U	6.0 U
Vanadium (V)	550		1,000 N	21.8	32.4	31.5	28.3	7.3	6.2	10.4	★ 32.4	★ 33.9	43.2
Zinc (Zn)	23,000		310,000 N	78.0	96.1	84.5	99.5	16.1	21.0	17.3	★ 79.3	★ 59.8	99.8
Uranium (U)			200 N	41.9 J	52.6 J	47.8 J	48.4 J	9.2 J	10.0 J	11.5 J	★ 55.9 J	★ 53.2 J	84.2 J

J

U

★

\*\*

MCL/MCLG

RDSC

N

The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable. J- indicates possible low bias.

The analyte was not detected at or above the Contract Required Detection Limit (CRDL).

Concentrations determined to be greater than three times the sample selected as background (see discussion in text.).

Lead value for industrial soil is from EPA Lead Sites Workgroup (EPA 2004g).

Lower than Contract Laboratory Program (CLP) standard detection limits.

Greater than the SCDM RDSC or CRSC or the Region 3 RBCs.

Maximum Contaminant Level/Maximum Contaminant Level Goal.

Reference Dose Screening Concentration.

Non-carcinogenic effects.

Sources: EPA 2004b (SCDM); EPA 2004a (Region 3 RBCs).

\*No background wetlands sample is available for comparison.

CRSCCancer Risk Screening Concentration.

SCDMSuperfund Chemical Data Matrix.

RBCsRisk-Based Concentrations.

**TABLE 11**  
**Sediment Samples Radiological Analytical Results**  
**(Concentrations in picocuries per gram (pCi/g))**

Sample ID	Location	Radium 226	Radium 228	Gross Alpha	Gross Beta
		Result ±TPU	Result ±TPU	Result ±TPU	Result ±TPU
EPA Remediation Goal		5*			
VB-SE-01	Butte Mill Ditch (Background)	1.94 ±0.497 J	4 U	25.1 ± 6.78	34.5 ± 9.44
VB-SE-10	Butte Mill Ditch at Keeter Silos	1.61 ±0.518 J	4 U	37 ± 7.95	46 ± 11.3
VB-SE-02	Butte Mill Ditch	2 U	4 U	28.5 ± 6.84	34.6 ± 8.35
VB-SE-03	Butte Mill Ditch	2 U	4 U	20.1 ± 6.08	26.4 ± 9.05
VB-SE-04	S. Boulder Creek (Background)	1.6 ±0.438 J	3.55 ±1.84 J	29 ± 6.62	36.1 ± 8.78
VB-SE-05	S. Boulder Creek	2 U	4 U	10 U	27 ± 17.2
VB-SE-09	Rogers Pond (Background)	2 U	4 U	17.7 ± 6.1	35.2 ± 12.7
VB-SE-07	Boulder Ready Mix Concrete Pond	2 U	3.14 ±1.84 J	19.5 ± 5.92	27.6 ± 9.09
VB-SE-06	Keeter Pond	2 U	4 U	10.3 ± 5.11	32.6 ± 15.8
VB-SE-08	On-site Wetlands	2 U	4 U	46.1 ± 8.46	40.8 ± 8.35

J The associated numeric value is estimated because quality control criteria were not met. Presence of the substance is reliable.

U The substance was not detected at or above the reported concentration.

\* The remediation goal is for residential soil only and is presented here for screening purposes.


TPU Total Propagated Uncertainty.


TABLE 12  
Groundwater Samples Total Inorganic Analytical Results  
Concentrations in µg/L (ppb)

Sample ID: Lab Sample ID: Location: Analyte      (Abbrev)	SCDM (Drinking Water) (1/28/2004)			Region 3 RBCs for Tap Water (04/2004)	VB-GW-01 MH17Q5 Background OSMP Property	VB-GW-02 MH17Q7 Background OSMP Property	VB-GW-05 MH17R6 Keeter yard 6379 Valmont	VB-TW-01 MH17L9 Terracon well MW-1	VB-TW-04 MH17N9 Terracon well MW-4	VB-TW-05 MH17M1 Terracon well MW-5	VB-TW-06 MH17R1 Southeast corner of Site	VB-TW-07 MH17R3 Duplicate VB-TW-06
	MCL/MCLG	RDSC	CRSC									
Antimony      (Sb)	6.0	15		15 N	2.0 U	2.0 U	2.0 U	4.0 U	2.0 U	4.0 U	4.0 U	4.0 U
Arsenic      (As)	50 [10 ††]	11	0.057	0.045 C	2.0	16.5	1.0 U	16.1	1.5 UJ	6.1	24.9	22.3 J
Barium      (Ba)	2,000	2,600		2,600 N	45.9	181	67.9	609	1,350 J	132	296	235
Beryllium      (Be)	4.0	73		73 N	1.0 U	0.37 J+	1.0 U	11.6 J+	6.3 J+	0.83 J+	0.50 J+	0.56 J+
Cadmium      (Cd)	5.0	18		18 N	1.0 U	2.0 U	1.0 U	5.1 J	1.3 J	1.04	1.0 UJ	1.0 UJ
Chromium      (Cr)	100	110			2.0 U	11.5	2.0 U	109	39.8 J	33.8	9.2 J	11.9 J
Cobalt      (Co)				730 N	0.37 J	3.5	0.48 J-	30.8	76.3 J	7.6	4.3 J	4.4 J
Copper      (Cu)	1,300			1,500 N	2.0 U	17.4	1.6 J	37.7	198 J	28.6	17.8 J	25.4 J
Lead      (Pb)	15				1.0 U	26.8	0.46 J	429	67.2 J	24.2	89.5	156
Manganese      (Mn)		5,100		730 N	1.1	668	100	1,180	3,250 J	810	275 J	253 J
Mercury      (Hg)	2.0	11		-	0.20 U	0.20 U	0.20 U	0.20 U	0.2 UJ	0.20 U	0.20 U	0.20 U
Nickel      (Ni)		730		730 N	2.3	13.3	1.9	80.5	46.4 J	37.9	13.0 J	13.8 J
Selenium      (Se)	50	180		180 N	0.31 J	1.6 J	1.1 J	46.8*	5.0 UJ	27.0	785 J	873 J
Silver      (Ag)		180		180 N	1.0 U	2.0 U	1.0 U	2.5 J	1.0 UJ	1.0 UJ	1.0 UJ	1.0 UJ
Thallium      (Tl)	0.50			2.6 N	1.0 U	0.11 J	0.12 J	2.9	0.29 J	0.41 J	0.18 J	0.17 J
Vanadium      (V)		260		37 N	1.0 U	21.7	1.5 J-	85.3	76.9 J	24.2	17.9 J	21.3 J
Zinc      (Zn)		11,000		11,000 N	0.94 J	48 5	2.1	171	49.5 J	359	51.2 J	99.2 J
Uranium      (U)	30			7.3 N	30 UJ	30 UJ	30 UJ	82.6 J	60 UJ	60 UJ	60 UJ	60 UJ

J                    The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable. J+ indicates possible high bias; J- indicates possible low bias.

U                    The analyte was not detected at or above the Contract Required Detection Limit (CRDL).

                    Lower than Contract Laboratory Program (CLP) standard detection limits.

                    The concentration detected is greater than one or ore benchmarks.

MCL/MCLG        Maximum Contaminant Level/Maximum Contaminant Level Goal.

RDSC              Reference Dose Screening Concentration.

CRSC              Cancer Risk Screening Concentration.

SCDM              Superfund Chemical Data Matrix.

RBCs              EPA Region 3 Risk-Based Concentrations.

N                    Non-carcinogenic effects.

C                    Carcinogenic effects.

††                  EPA adopted a new MCL for arsenic in drinking water (10 µg/L) on January 22, 2001, and public water systems must comply with the 10 µg/L standard beginning January 23, 2006. See EPA 2002d.

\*                    Interference; results of serial dilution indicates probable matrix interference due to muddy sample.

Sources: EPA 2004b (SCDM); EPA 2004a (Region 3 RBCs)

TABLE 13  
Groundwater Samples Dissolved Inorganic Analytical Results  
Concentrations in µg/L (ppb)

Sample ID: Lab Sample ID: Location: Analyte (Abbrev)	SCDM (Drinking Water) (1/28/2004)			Region 3 RBCs for Tap Water (04/2004)	VB-GW-01D MH17Q6 Background OSMP Property	VB-GW-02D MH17Q8 Background OSMP Property	VB-GW-05D MH17R7 Keeter yard 6379 Valmont	VB-TW-01D MH17M0 Terracon well MW-1	VB-TW-05D MH17M2 Terracon well MW-5	VB-TW-04D MH17P0 Terracon well MW-4	VB-TW-06D MH17R2 Southeast corner of Site	VB-TW-07D MH17R4 Duplicate of VB-TW-06
	MCL/MCLG	RDSC	CRSC									
Antimony (Sb)	6.0	15		15 N	2.0 U	2.0 U	2.0 U	2.0 UJ	2.0 UJ	2.0 UJ	2.0 UJ	2.0 U
Arsenic (As)	50 [10 ††]	11	0.057	0.045 C	3.3	15.7	1.0 U	10.2	1.7	0.88 J	24.2	21.7
Barium (Ba)	2,000	2,600		2,600 N	58.3	81.9	64.2	16.3	15.5	38.1	17.4	18.8
Beryllium (Be)	4.0	73		73 N	1.0 UJ	1.0 UJ	2.0 UJ	2.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Cadmium (Cd)	5.0	18		18 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chromium (Cr)	100	110			2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2/0 U	2.1 U
Cobalt (Co)				730 N	1.0 U	2.7	1.8	7.7	2.9	3.4	2.5	0.98 J-
Copper (Cu)	1,300			1,500 N	0.43 J	3.9 U	1.6 J	5.5	4.6	11.8	3.3	3.4
Lead (Pb)	15				0.20 U	0.20 U	0.17 J	5.0	1.0 U	1.0 U	0.08 J	0.12 J
Manganese (Mn)		5,100		730 N	19.7	485	106	676	263	18.2	9.3	9.3
Mercury (Hg)	2.0	11		-	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Nickel (Ni)		730		730 N	2.9	5.3	1.8	20.6	17.1	6.7	13.3	14.1
Selenium (Se)	50	180		180 N	0.30 J	2.1 J	1.0 J	531	45.0	13.9	1,330	1,350
Silver (Ag)		180		180 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Thallium (Tl)	0.50			2.6 N	1.0 U	1.0 U	0.13 J	0.07 J	1.0 U	1.0 U	1.0 U	1.0 U
Vanadium (V)		260		37 N	1.0 U	3.7	0.88 J	1.0 U	1.0 U	2.0	1.0 U	1.0 U
Zinc (Zn)		11,000		11,000 N	2.0 U	4.0	2.7 U	14.1	35.3	4.1	14.3	16.5
Uranium	30			7.3 N	30.0 UJ	30.0 UJ	30.0 UJ	58.2 J	44.9 J	30 UJ	44.1 J	43.9 J

J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable. J- indicates possible low bias.  
U The analyte was not detected at or above the Contract Required Detection Limit (CRDL).  
The benchmark is lower than Contract Laboratory Program (CLP) standard detection limits.  
The concentration detected is greater than one or more benchmarks.  
MCL/MCLG Maximum Contaminant Level/Maximum Contaminant Level Goal.  
RDSC Reference Dose Screening Concentration.  
CRSC Cancer Risk Screening Concentration.  
SCDM Superfund Chemical Data Matrix.  
RBCs Risk-Based Concentrations.  
N Non-carcinogenic effects.  
C Carcinogenic effects.  
†† EPA adopted a new MCL for arsenic in drinking water (10 µg/L) on January 22, 2001, and public water systems must comply with the 10 µg/L standard beginning January 23, 2006.

Sources: EPA 2004b (SCDM); EPA 2004a (Region 3 RBCs)

**TABLE 14**  
**Groundwater Samples Radiological Analytical Results**  
**(Concentrations in picocuries per liter (pCi/L))**

Sample IDLocation		Radium 226		Radium 228		Ra 226 + Ra 228 †		Gross Alpha		Uranium***		Adjusted * †† Gross Alpha		Gross Beta	
		Result ± TPU		Result ± TPU				Result ± TPU						Result ± TPU	
EPA SDWA MCLs						5						15		50**	
VB-GW-01	Background OSMP Property	1	U	1.4	U	2.4	3	U	0	3	11.1	± 3.42			
VB-GW-02	Background OSMP Property	1	U	1.4	U	2.4	3	U	0	3	6.23	± 4.56			
VB-GW-05	Keeter yard 6379 Valmont	1	U	1.4	U	2.4	3	U	0	3	4	U			
VB-TW-01	Terracon well MW-1	17.6	± 0.708	20	± 1.35	37.6	82.2	± 11.2	56.32 J	25	83.7	± 11.6			
VB-TW-04	Terracon well MW-4	6.01	± 0.425	12.4	± 1.1	18.41	174	± 41.5	0	174	381	± 75.5			
VB-TW-05	Terracon well MW-5	2.56	± 0.337	4.97	± 0.894	7.53	95.3	± 21.5	0	95.3	163	± 33.6			
VB-TW-06	Southeast corner of site	2.1	± 0.342	1.99	± 0.646	4.09	418	± 38.1	0	418	430	± 41			
VB-TW-07	Duplicate of VB-TW-06	1.66	± 0.308	5.95	± 0.778	7.61	118	± 21.6	0	118	129	± 42.8			

J The associated numeric value is estimated because quality control criteria were not met. Presence of the substance is reliable.  
 U The substance was not detected at or above the reported concentration. pCi/L Picocuries per liter. µg/L Micrograms per liter  
 \*\* The Regulatory benchmark of 50 pCi/L is for man-made isotopes. Radioactive material at this site are NORMs. This benchmark is used for screening purposes only.  
 Uranium and radon are not included in the Adjusted Gross Alpha; The concentration of uranium has been subtracted from the Gross Alpha result.  
 TPU Total Propagated Uncertainly.  
 † For Radium 226 and 228 nondetects, a amount equal to the detection limit is used in the calculation as a conservative estimate.  
 †† EPA adopted a new MCL for arsenic in drinking water (10 µg/L) on January 22, 2001, and public water systems must comply with the 10 µg/L standard beginning January 23, 2006.  
 \* For Gross Alpha nondetects, an amount equal to the detection limit is used in the calculation as a conservative estimate; for uranium nondetects, zero is used in the calculation as a conservative estimate.  
 \*\*\* The total inorganic uranium listed in Table 12 was converted to pCi/L by multiplying the concentration in µg/L by the factor (30 pCi/L) divided by (44 µg/L) (Source: EPA 2004c).  
 ☐ The concentration detected is greater than the EPA Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) (EPA 2004b (SCDM)).

TABLE 15  
Groundwater Samples Wet Chemistry Analytical Results  
(Concentrations in milligrams per liter (mg/L))

Sample ID: Lab Sample ID: Location:  Analyte	VB-GW-01 D4H270400-009 Background OSMP Property	VB-GW-02 D4H270400-010 Background OSMP Property	VB-GW-05 D4H270400-011 Keeter yard 6379 Valmont	VB-TW-01 D4H260343-026 Terracon well MW-1	VB-TW-04 D4H260343-027 Terracon well MW-4	VB-TW-05 D4H260343-028 Terracon well MW-5	VB-TW-06 D4H270400-012 Southeast corner of Site	VB-TW-07 D4H270400-013 Duplicate VB-TW-06
Bicarbonate Alkalinity	5.0 U	190	230	470	360	280	270	250
Carbonate Alkalinity	27	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Hydroxide Alkalinity	65	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Total Alkalinity	92	190	230	470	360	280	270	250
Chloride	43	27	35	120	69	59	330	330
Fluoride	0.17 J	4.6	0.91 J	5.0 U	3.4	5.0 U	5.0 U	5.0 U
Nitrate	5.0 U	5.0 U	0.25 J-	20 J-	0.36 J-	0.95 J-	58 J-	60 J-
Nitrite	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Sulfate	13	1.6 J	41	3,300	670	3,000	2,500	2,500
Lab Sample ID:  Analyte	MH17Q5/MH17Q6 Total	MH17Q7/MH17Q8 Total	MH17R6/MH17R7 Total	MH17L9/MH17M0 Total	MH17N9/MH17P0 Total	MH17M1/MH17M2 Total	MH17R1/MH17R2 Total	MH17R3/MH17R4 Total
Calcium	47	32.9	51.1	670	174	448	480	487
Sodium	41.4	65.3	41.2	580	261	464	514	552
Magnesium	1.56	8.24	22.5	473	99.1	261	238	248
Iron	120	5,920	303	7,940	18,100	9,210	4,210	9,20
Lab Sample ID:  Analyte	MH17Q5/MH17Q6 Dissolved	MH17Q7/MH17Q8 Dissolved	MH17R6/MH17R7 Dissolved	MH17L9/MH17M0 Dissolved	MH17N9/MH17P0 Dissolved	MH17M1/MH17M2 Dissolved	MH17R1/MH17R2 Dissolved	MH17R3/MH17R4 Dissolved
Calcium	33.5	25.5	51.4	451	114	439	493	463
Sodium	41.3	69.2	43.5	707	269	548	698	680
Magnesium	0.46	5.72	22.4	329	80.3	259	253	240
Iron	100 U	508	100 U	100 U	100 U	100 U	100 U	100 U

J  
U

The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable. J- indicates possible low bias.  
The analyte was not detected at or above the CRDL.

TABLE 16  
Drinking Water Samples Total Inorganic Analytical Results  
Concentrations in µg/L (ppb)

Sample ID: Lab Sample ID: Location: Analyte (Abbrev)	SCDM (Drinking Water) (1/28/2004)			Region 3 RBCs for Tap Water (04/2004)	VB-DW-01 MH17M3 McGinty 3152 Indian School	VB-DW-02 MH17M5 Hart 6017 Valmont Rd	VB-DW-03 MH17P1 McGinty 5987 Valmont Rd	VB-DW-04 MH17N3 Rogers 5973 Indian School	VB-DW-05 MH17N5 Botteril/Houck 6327 Valmont Rd	VB-DW-06 MH17N7 Melton/Mitchell 6029 Indian School
	MCL/MCLG	RDSC	CRSC							
Antimony (Sb)	6.0	15		15 N	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Arsenic (As)	50 [10 ††]	11	0.057	0.045 C	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.1
Barium (Ba)	2,000	2,600		2,600 N	48.4	48.9	42.0	96.1	45.8	170
Beryllium (Be)	4.0	73		73 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Cadmium (Cd)	5.0	18		18 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chromium (Cr)	100	110			2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Cobalt (Co)				730 N	1.0 U	1.6	2.0	1.0 U	1.0 U	1.0 U
Copper (Cu)	1,300			1,500 N	3.9	10.6	9.9 J-	9.7	45.1	26.1
Lead (Pb)	15				0.14 J	0.09 J	0.29 J	0.13 J	0.53 J	4.8
Manganese (Mn)		5,100		730 N	6.1	18.0	0.68	6.0	3.9	22.7
Mercury (Hg)	2.0	11		-	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Nickel (Ni)		730		730 N	1.3	14.8	15.5	2.4	1.0 U	4.8
Selenium (Se)	50	180		180 N	5.04	1.6 J	1.6 J	5.0 U	5.0 U	5.0 U
Silver (Ag)		180		180 N	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U
Thallium (Tl)	0.50			2.6 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vanadium (V)		260		37 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	3.7
Zinc (Zn)		11,000		11,000 N	6.4	12.1	41.4 J-	4.9	10.2	9.8
Uranium (U)	30			7.3 N	30 UJ	30 UJ	30 UJ	30 UJ	30 UJ	30 UJ

J  
U  
††  

MCL/MCLG  
RDSC  
CRSC  
SCDM  
RBCs  
N  
C

The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable. J- indicates possible low bias.  
The analyte was not detected at or above the CRDL.  
EPA adopted a new MCL for arsenic in drinking water (10 µg/L) on January 22, 2001, and public water systems must comply with the 10 µg/L standard beginning January 23, 2006. See EPA 2002d.  
Lower than Contract Laboratory Program (CLP) standard detection limits.  
The concentration detected is greater than one or more benchmarks.  
Maximum Contaminant Level/Maximum Contaminant Level Goal.  
Reference Dose Screening Concentration.  
Cancer Risk Screening Concentration.  
Superfund Chemical Data Matrix.  
Risk-Based Concentrations.  
Non-carcinogenic effects.  
Carcinogenic effects.

Sources: EPA 2004b (SCDM); EPA 2004a (Region 3 RBCs)

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TABLE 16  
Drinking Water Samples Total Inorganic Analytical Results  
Concentrations in µg/L (ppb)  
(continued)

Sample ID: Lab Sample ID: Location: Analyte (Abbrev)	SCDM (Drinking Water) (1/28/2004)			Region 3 RBCs for Tap Water (04/2004)	VB-DW-07 MH17P3 Erickson 6188 Valmont Rd	VB-DW-08 MH17P5 Keeter 6379 Valmont Rd	VB-DW-09 MH17P7 Keeter 6423 Valmont Rd	VB-DW-10 MH17P9 Khalsa 6717 Valmont Rd	VB-DW-11 MH17Q1 Schouweiler 6903 Valmont Rd	VB-DW-12 MH17Q3 Bray 7087 Valmont Rd	VB-DW-21 MH17Q9 Duplicate VB-DW-07
	MCL/MCLG	RDSC	CRSC								
Antimony (Sb)	6.0	15		15 N	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Arsenic (As)	50 [10 ††]	11	0.057	0.045 C	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Barium (Ba)	2,000	2,600		2,600 N	61.8	60.3	49.3	33.1	73.0	85.0	63.3
Beryllium (Be)	4.0	73		73 N	1.0 U	2.0 U	2.0 U	2.0 U	1.0 U	1.0 U	1.0 U
Cadmium (Cd)	5.0	18		18 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chromium (Cr)	100	110			2.0 UJ	2.0 U	2.0 U	2.0U	2.0 U	2.7 U	2.0 U
Cobalt (Co)				730 N	1.2	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.07 J-
Copper (Cu)	1,300			1,500 N	10.0 J-	16.9	22.7	17.2	14.2	95.0	12.1
Lead (Pb)	15				0.09 J	0.75 J	0.30 J	0.34 J	0.75 J	0.71 J	0.30 J
Manganese (Mn)		5,100		730 N	2.1	1.0 U	0.61 J	70.2	2.0	7.1	0.37 J
Mercury (Hg)	2.0	11		-	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Nickel (Ni)		730		730 N	4.3	1.1	1.2	1.7	1.1	4.2	4.0
Selenium (Se)	50	180		180 N	1.5 J	0.45 J	6.7	0.68 J	0.42 J	1.9 J	1.3 J
Silver (Ag)		180		180 N	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Thallium (Tl)	0.50			2.6 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vanadium (V)		260		37 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Zinc (Zn)		11,000		11,000 N	6.8 J-	4.3	3.5	29.4	35.7	10.0	6.8
Uranium (U)	30			7.3 N	30 UJ	30 UJ	30 UJ	30 UJ	30 UJ	30 UJ	30 UJ

J  
U  
††  
  
MCL/MCLG  
RDSC  
CRSC  
SCDM  
RBCs  
N  
C

The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable. J- indicates possible low bias.  
The analyte was not detected at or above the CRDL.  
EPA adopted a new MCL for arsenic in drinking water (10 µg/L) on January 22, 2001, and public water systems must comply with the 10 µg/L standard beginning January 23, 2006. See EPA 2002 (MCLs).  
Lower than Contract Laboratory Program (CLP) standard detection limits.  
Maximum Contaminant Level/Maximum Contaminant Level Goal.  
Reference Dose Screening Concentration.  
Cancer Risk Screening Concentration.  
Superfund Chemical Data Matrix.  
Risk-Based Concentrations.  
Non-carcinogenic effects.  
Carcinogenic effects.

Sources: EPA 2004b (SCDM); EPA 2004a (Region 3 RBCs)

TABLE 17  
Drinking Water Samples Dissolved Inorganic Analytical Results  
Concentrations in µg/L (ppb)

Sample ID: Lab Sample ID: Location: Analyte (Abbrev)	SCDM (Drinking Water) (1/28/2004)			Region 3 RBCs for Tap Water (04/2004)	VB-DW -01D MH17M4 McGinty 3152 Indian School	VB-DW -02D MH17M6 Hart 6017 Valmont Rd	VB-DW -03D MH17P2 McGinty 5987 Valmont Rd	VB-DW -04D MH17N4 Rogers 5973 Indian School	VB-DW -05D MH17N6 Botteril/Houck 6327 Valmont Rd	VB-DW -06D MH17N8 Melton/Mitchell 6029 Indian School	VB-DW -07D MH17P4 Erickson 6188 Valmont Rd
	MCL/MCLG	RDSC	CRSC								
Antimony (Sb)	6.0	15		15 N	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Arsenic (As)	50 [10 ††]	11	0.057	0.045 C	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.2	1.0 U
Barium (Ba)	2,000	2,600		2,600 N	47.5	46.5	43.9	96.7	46.3	170	63.3
Beryllium (Be)	4.0	73		73 N	1.0 U	1.0 U	1.0 UJ	1.0 U	1.0 U	1.0 U	1.0 UJ
Cadmium (Cd)	5.0	18		18 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chromium (Cr)	100	110			2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Cobalt (Co)				730 N	0.97 J-	2.7	2.3	1.1	1.2	1.1	0.24 J-
Copper (Cu)	1,300			1,500 N	2.9	1.8 J	9.4	9.2	30.5	21.7	14.4
Mercury (Hg)	2.0	11		-	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.24	0.20 U
Lead (Pb)	15				0.09 J	1.0 U	0.12 J	0.07 J	0.28 J	2.3	0.38 J
Manganese (Mn)		5,100		730 N	7.6	18.5	0.38 J	3.7	6.2	25.3	0.35 J
Nickel (Ni)		730		730 N	1.7	15.9	16.0	2.7	0.92 J	4.8	4.2
Selenium (Se)	50	180		180 N	5.0 U	1.5 J	1.8 J	0.35 J	5.0 U	0.77 J	1.5 J
Silver (Ag)		180		180 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Thallium (Tl)	0.50			2.6 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Vanadium (V)		260		37 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	3.0	1.0 U
Zinc (Zn)		11,000		11,000 N	8.8	13.7	43.6	6.8	13.2	11.6	10.0
Uranium (U)	30			7.3 N	30 UJ	30 UJ	30.0 UJ	30 UJ	30 UJ	30 UJ	30.0 UJ

JThe associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable. J- indicates possible low bias.

UThe analyte was not detected at or above the CRDL.

††EPA adopted a new MCL for arsenic in drinking water (10 µg/L) on January 22, 2001, and public water systems must comply with the 10 µg/L standard beginning January 23, 2006. See EPA 2002d.

Lower than Contract Laboratory Program (CLP) standard detection limits.

The concentration detected is greater than one or more benchmarks.

MCL/MCLGMaximum Contaminant Level/Maximum Contaminant Level Goal.

RDSCReference Dose Screening Concentration.

CRSCCancer Risk Screening Concentration.

SCDMSuperfund Chemical Data Matrix.

RBCsRisk-Based Concentrations.

NNon-carcinogenic effects.

CCarcinogenic effects.

Sources: EPA 2004b (SCDM); EPA 2004a (Region 3 RBCs)

TABLE 17  
Drinking Water Samples Dissolved Inorganic Analytical Results  
Concentrations in µg/L (ppb)  
(continued)

Sample ID: Lab Sample ID: Location: Analyte (Abbrev)	SCDM (Drinking Water) (1/28/2004)			Region 3 RBCs for Tap Water (04/2004)	VB-DW-08D MH17P6 Erickson 6188 Valmont Rd	VB-DW-09D MH17P8 Keeter 6423 Valmont Rd	VB-DW-10D MH17Q0 Khalsa 6717 Valmont Rd	VB-DW-11D MH17Q2 Schouweiler 6903 Valmont Rd	VB-DW-12D MH17Q4 Bray 7087 Valmont Rd	VB-DW-21D MH17R0 Duplicate VB-DW-07
	MCL/MCLG	RDSC	CRSC							
Antimony (Sb)	6.0	15		15 N	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Arsenic (As)	50 [10 ††]	11	0.057	0.045 C	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Barium (Ba)	2,000	2,600		2,600 N	60.5	49.0	31.2	72.7	86.8	63.6
Beryllium (Be)	4.0	73		73 N	1.0 UJ	1.0 UJ	1.0 UJ	1.0 UJ	1.0 UJ	1.0 UJ
Cadmium (Cd)	5.0	18		18 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Chromium (Cr)	100	110			2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Cobalt (Co)				730 N	1.3	1.2	1.4	0.14 J-	1.4	1.1
Copper (Cu)	1,300			1,500 N	9.3	20.9	11.4	10.8	113	10.3
Mercury (Hg)	2.0	11		-	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U	0.20 U
Lead (Pb)	15				0.14 J	0.26 J	1.0 U	0.14 J	0.39 J	0.08 J
Manganese (Mn)		5,100		730 N	2.2	2.5	62.4	2.0	7.4	1.8
Nickel (Ni)		730		730 N	0.98 J	1.4	1.9	1.3	4.7	4.6
Selenium (Se)	50	180		180 N	0.56 J	5.9	0.76 J	0.46 J	2.2 J	1.6 J
Silver (Ag)		180		180 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U
Thallium (Tl)	0.50			2.6 N	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	10. U
Vanadium (V)		260		37 N	1.0 U	1.1	1.0 U	1.0 U	1.0 U	1.0 U
Zinc (Zn)		11,000		11,000 N	6.0	5.3	28.5	14.1	14.5	7.0
Uranium (U)	30			7.3 N	30.0 UJ	30.0 UJ	30.0 UJ	30.0 UJ	30.0 UJ	30.0 UJ

JThe associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable. J- indicates possible low bias.

UThe analyte was not detected at or above the CRDL.

††EPA adopted a new MCL for arsenic in drinking water (10 µg/L) on January 22, 2001, and public water systems must comply with the 10 µg/L standard beginning January 23, 2006. See EPA 2002d.

Lower than Contract Laboratory Program (CLP) standard detection limits.

The concentration detected is greater than one or more benchmarks.

MCL/MCLGMaximum Contaminant Level/Maximum Contaminant Level Goal.

RDSCReference Dose Screening Concentration.

CRSCCancer Risk Screening Concentration.

SCDMSuperfund Chemical Data Matrix.

RBCsRisk-Based Concentrations.

NNon-carcinogenic effects.

CCarcinogenic effects.

Sources: EPA 2004b (SCDM); EPA 2004a (Region 3 RBCs)

**TABLE 18**  
**Drinking Water Samples Radiological Analytical Results**  
**(Concentrations in Picocuries per liter (pci/L))**

	Radium 226	Radium 228	Ra 226 + Ra 228 †	Gross Alpha	Total Uranium	Adjusted*†† Gross Alpha	Gross Beta
Sample ID	Result ±TPU	Result ±TPU		Result ±TPU	pci/L		Result ±TPU
<b>EPA SDWA MCL</b>			<b>5</b>			<b>15</b>	<b>50**</b>
VB-DW-01	1 U	1.4 U	2.4	3 U	0	3	6.86 ± 18
VB-DW-02	1 U	1.4 U	2.4	3 U	0	3	4 U
VB-DW-03	1 U	1.4 U	2.4	11.4 ± 3.14	0	11.4	4 U
VB-DW-04	1 U	1.4 U	2.4	4.13 ± 1.64	0	4.13	6.29 ± 2.51
VB-DW-05	1 U	1.4 U	2.4	3 U	0	3	2.14 ± 2.18 J
VB-DW-06	1 U	1.4 U	2.4	4.22 ± 1.87	0	4.22	12.2 ± 5.14
VB-DW-07	1 U	0.958 ± 0.576 J	1.958	6.85 ± 2.76	0	6.85	4 U
VB-DW-08	1 U	1.4 U		3 U	0	3	4 U
VB-DW-09	1 U	1.4 U	2.4	3 U	0	3	5.3 ± 9.24
VB-DW-10	1 U	1.4 U	2.4	2.62 ± 0.99 J	0	2.62	2.06 ± 1.44 J
VB-DW-11	1 U	1.4 U	2.4	2.53 ± 0.982 J	0	2.53	4 U
VB-DW-12	1 U	1.4 U	2.4	3 U	0	3	4 U
VB-DW-21	1 U	1.4 U	2.4	6.04 ± 3.33	0	6.04	4 U

J The associated numeric value is estimated because quality control criteria were not met. Presence of the substance is reliable.  
 U The substance was not detected at or above the reported concentration.  
 \*\* The Regulatory benchmark of 50 pci/L for Gross Beta is for man-made isotopes. Radioactive material at this site are NORMs. This benchmark is used for screening purposes only.  
 \* Uranium and radon are not included in the Adjusted Gross Alpha; The concentration of uranium has been subtracted from the Gross Alpha result.  
 TPU Total Propagated Uncertainty.  
 † For Radium 226 and 228 nondetects, a amount equal to the detection limit is used in the calculation as a conservative estimate.  
 †† For Gross Alpha nondetects, an amount equal to the detection limit is used in the calculation as a conservative estimate; for uranium nondetects, zero is used in the calculation as a conservative estimate. All uranium data was qualified as nondetect based on laboratory QA review.  
 SDWA MCL Safe Drinking Water Act Maximum Contaminant Level (EPA 2004b (SCDM)).

TABLE 19  
Drinking Water Samples Wet Chemistry Analytical Results  
(Concentrations in milligrams per liter (mg/L))

Sample ID: Lab Sample ID: Location:	VB-DW-01 D4H260343-001 McGinty 3152 Indian School	VB-DW-02 D4H260343-002 Hart 6017 Valmont Road	VB-DW-03 D4H270400-001 McGinty 5987 Valmont Road	VB-DW-04 D4H260343-003 Rogers 5973 Indian School	VB-DW-05 D4H260343-004 Botteril/Houck 6327 Valmont Road	VB-DW-06 D4H260343-005 Melton/Mitchell 6029 Indian School	VB-DW-07 D4H270400-002 Erickson 6188 Valmont Road	VB-DW-21 D4H270400-008 Duplicate of VB-DW-07	VB-DW-08 D4H270400-003 Keeter 6379 Valmont Road	VB-DW-09 D4H270400-004 Keeter 6423 Valmont Road	VB-DW-10 D4H270400-005 Khalsa 6717 Valmont Road	VB-DW-11 D4H270400-006 Schouweiler 6903 Valmont Road	VB-DW-12 D4H270400-007 Bray 7087 Valmont Road
Bicarbonate Alkalinity	130	340	290	280	83	270	300	300	99	110	150	190	470
Carbonate Alkalinity	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Hydroxide Alkalinity	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U	5.0 U
Total Alkalinity	130	340	290	280	83	270	300	300	99	110	150	190	470
Chloride	34	230	150	54	25	100	250	240	28	41	36	33	62
Fluoride	0.66 J	8.1	3.0	1.0	0.53 J	0.77 J	1.0 U	1.4	0.82 J	0.74 J	0.91 J	0.59 J	2.7
Nitrate	0.5 U	8.6	2.9 J-	0.39 J-	0.5 U	1.4 J-	043 J-	0.43 J-	0.29 J-	0.51 J-	0.25 J-	0.28 J-	0.24 J-
Nitrite	0.5 U	5.4	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Sulfate	38	430	560	98	32	210	110	110	31	110	54	24	280
Lab Sample ID: Analyte	MH17M3/ MH17M4 Total	MH17M5/ MH17M6 Total	MH17P1/ MH17P2 Total	MH17N3/ MH17N4 Total	MH17N5/ MH17N6 Total	MH17N7/ MH17N8 Total	MH17P3/ MH17P4 Total	MH17Q9/ MH17R0 Total	MH17P5/ MH17P6 Total	MH17P7/ MH17P8 Total	MH17P9/ MH17Q0 Total	MH17Q1/ MH17Q2 Total	MH17Q3/ MH17Q4 Total
Calcium	39	152	161	64.5	27.2	124	79.3	82.2	31.2	43.5	31	57.9	117
Sodium	26.2	149	143	77.4	19.6	65.8	89.9	93.1	19.7	47.1	53.8	21.6	105
Magnesium	15.5	97.5	83.3	27.4	9.59	41.4	76.9	81.3	10.2	20.2	12	14.7	67.7
Iron	90.5 J	247	66.8 J	100 U	68.2 J	100 U	100 U	100 U	107	100 U	120	189	262
Lab Sample ID: Analyte	MH17M3/ MH17M4 Dissolved	MH17M5/ MH17M6 Dissolved	MH17P1/ MH17P2 Dissolved	MH17N3/ MH17N4 Dissolved	MH17N5/ MH17N6 Dissolved	MH17N7/ MH17N8 Dissolved	MH17P3/ MH17P4 Dissolved	MH17Q9/ MH17R0 Dissolved	MH17P5/ MH17P6 Dissolved	MH17P7/ MH17P8 Dissolved	MH17P9/ MH17Q0 Dissolved	MH17Q1/ MH17Q2 Dissolved	MH17Q3/ MH17Q4 Dissolved
Calcium	38.3	149	158	67.6	26.5	124	80.2	77.2	31.4	41.4	31.5	57.5	119
Sodium	27.3	156	150	86.8	20.9	79.4	94.5	93.2	20.5	47.8	56.3	22.1	10108
Magnesium	15.5	95.5	80.7	28.5	9.14	39.3	76.4	72.6	10.1	18.3	12	14.2	66.7
Iron	87.8 J-	129	100 U	100 U	145	100 U	100 U	50.0 J-	100 U	100 U	100 U	100 U	36.2 J

J

The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable. J- indicates possible low bias.

U

The analyte was not detected at or above the CRDL.

**TABLE 20**  
**Duplicate XRF Data Comparison**  
**(Concentrations in milligrams per kilogram (mg/kg))**

Sample ID	Arsenic (As)	RPD %	Lead (Pb)	RPD %	Uranium (U)	RPD %
HMS-11	13 U		62	16%	22 U	
HMS-11D	16 J		53 J		22 U	
VB-BP-05-22	40 U		1,500	6%	64	2%
VB-BP-05-22D	42 U		1,600		63	
VB-BP-07-02	47 U		2,300	14%	29 U	
VB-BP-07-02D	43 U		2,000		29 U	
VB-BP-30-25	13 U		23 J	63%	22 U	
VB-BP-30-25D	13 U		44 J		21 U	
VB-BS-38-10	13 U		18 J	0%	21 U	
VB-BS-38-10D	13 U		18 J		21 U	
VB-BS-MO-03	18 U		360	0%	24 U	
VB-BS-MO-03D	19 U		360		24 U	
VB-SG-22	13 U		57 J	5%	23 U	
VB-SG-22D	13 U		60		23 U	
VB-SL-10	110	17%	1,300	7%	23 U	
VB-SL-10D	93		1,400		24 U	
VB-SL-22	17 U		350	27%	21 U	
VB-SL-22D	20 U		460		21 U	
VB-SL-37	22 U		490	6%	24 U	
VB-SL-37D	22 U		520		25 U	
VB-SU-12	22 U		480	10%	23 U	
VB-SU-12D	25 J		530		24 U	

J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable.  
 U The substance was not detected at or above the reported concentration.  
 XRF X-Ray Fluorescence  
 RPD Relative Percent Difference

**TABLE 21**  
**Blank Samples**  
**(Concentrations in milligrams per kilogram (mg/kg))**

Sample ID	Iron (Fe)	XRF	Laboratory
VB-BP-02-27B	180	20	54.4
VB-SL-04B	82	18	
VB-SL-16B	77	18	
VB-SU-10B	210	21	

TABLE 22  
Surface Soil Samples Inorganic Analytical Results\*  
(Concentrations in milligrams per kilogram (mg/kg (ppm)))

Sample ID: Lab Sample ID: Location: Analyte (Abbrev)	SCDM Soil Pathway		EPA Region 3 RBCs (04/2004)	VB-SL-20 MH1BH4 Background Valmont Butte	VB-SG-03 MH1BF2 Background Fence	VB-SG-04 MH1BF3 Background Fence	VB-SG-27 MH1BF4 Secondary Tailings Pond	VB-SU-04 MH1BF5 Surface water ditch	VB-SU-05 MH1BF6 6717 Valmont Road yard	VB-SU-08 MH1BF7 6379 Valmont Road yard	VB-SU-10 MH1BF8 6327 Valmont Road yard
	RDSC	CRSC	Industrial Soil								
Aluminum (Al)			1,000,000 N	21,800	11,700 J	13,700 J	14,300 J	7,760 J	11,200 J	13,800 J	11,600 J
Antimony (Sb)	31		410 N	5.8 UJ	5.8 UJ	5.9 UJ	5.6 UJ	5.9 UJ	5.5 UJ	5.2 UJ	5.2 UJ
Arsenic (As)	23	0.43	1.9 C	6.0 J+	9.1 J	7.8 J+	8.4 J	4.1 J+	5.1 J+	6.3 J+	5.8 J+
Barium (Ba)	5,500		72,000 N	152	258	245	192	103	109	160	115
Beryllium (Be)	160		2,000 N	0.48 U	0.48 U	0.49 U	0.47 U	0.49 U	0.46 U	0.43 U	0.43 U
Cadmium (Cd)	39		510 N	2.0 J+	2.8 J+	2.2 J+	1.9 J+	0.84 J+	1.0 J+	1.5 J+	1.1 J+
Calcium (Ca)				17,900	10,200 J	8,760 J	31,100 J	6,920 J	6,870 J	8,490 J	7,560 J
Chromium (Cr)	230			23.5	21.0	20.4	20.0	19.9	22.7	24.3	24.8
Cobalt (Co)			20,000 N	17.0 J	6.9	7.5	7.7	6.2	7.8	7.5	7.5
Copper (Cu)			41,000 N	74.0	40.4	34.4	37.3	21.9	21.9	29.0	24.4
Iron (Fe)			310,000 N	32,000	20,400 J	18,900 J	21,500 J	15,700 J	19,600 J	20,200 J	20,900 J
Lead (Pb)			800**	48.6 J	407	320	297	53.5	48.2	171	77.2
Magnesium (Mg)				11,200	4,110 J	4,080 J	8,190 J	3,680 J	4,400	4,840 J	4,010 J
Manganese (Mn)	11,000		20,000 N	753	369	363	299	220	292	282	282
Mercury (Hg)	23			0.10 U	0.10 UJ	0.10 U	0.10 UJ	0.10 U	0.10 U	0.10 U	0.10 U
Nickel (Ni)	1,600		20,000 N	16.5	12.0	13.6	15.4	12.3	13.8	14.1	12.6
Potassium (K)				4,130	3,580	4,360	3,150	2,500	3,990	4,270	3,560
Selenium (Se)	390		5,100 N	3.4 U	3.4 U	3.4 U	0.69 J+	3.4 U	3.2 U	3.0 U	3.0 U
Silver (Ag)	390		5,100 N	0.97 UJ	0.97 U	0.98 U	0.94 U	0.98 U	0.91 U	0.86 U	0.86 U
Sodium (Na)				1,140	153 J	141 J	56.7 J	111 J	82.0 J	160 J	114 J
Thallium (Tl)			72 N	2.4 U	2.4 UJ	2.5 UJ	2.3 UJ	2.5 UJ	2.3 UJ	2.2 UJ	2.2 UJ
Vanadium (V)	550		1,000 N	80.8	35.2	34.0	40.3	28.0	38.5	43.3	42.3
Zinc (Zn)	23,000		310,000 N	92.0 J	603	358	206	91.1	93.0	171	96.4
Uranium (U)			200 N	23.0 UJ	30.0 J	24.5 J	20.1 UJ	17.7 UJ	20.3 J	24.0 J	24.3 J

J  
U  
\*  
  
RDSC  
SCDM  
N

The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable. J+ indicates possible high bias.  
The analyte was not detected at or above the CRDL.  
Samples were collected from zero to one inch below ground surface (bgs) unless noted otherwise.  
Lower than Contract Laboratory Program (CLP) standard detection limits.  
The concentration detected is greater than one or more benchmarks.  
Reference Dose Screening Concentration.  
Superfund Chemical Data Matrix.  
Non-carcinogenic effects.

CRSC  
RBCs  
C

Cancer Risk Screening Concentration.  
Risk-Based Concentrations.  
Carcinogenic effects.

\*\* EPA Lead Sites Workgroup (EPA 2004g).

Sources: EPA 2004b (SCDM); EPA 2004a (Region 3 RBCs).

TABLE 22  
Surface Soil Samples Inorganic Analytical Results  
Concentrations in milligrams per kilogram (mg/kg (ppm))  
(continued)

Sample ID: Lab Sample ID: Location: Analyte (Abbrev)	SCDM Soil Pathway		RBCs*	VB-SU-12D MH1BF9 Area 3 Wood Shop	VB-SU-13 MH1BG0 Area 5 - Ore Storage Area	VB-SL-10 MH1BG1 North and east of ASTs	VB-SL-01 MH17M7 Used Parts Area	VB-BD-M0-01 MH1BH0 Disposal Pit 0-1 in composite	VB-BD-M0-03 MH1BH1 Disposal Pit 0-1 in composite	VB-BD-MS-02 MH1BH2 Disposal Pit 1-18 inch composite	VB-SL-23 MH1BH5 Railroad Bed
	RDSC	CRSC	Industrial Soil								
Aluminum (Al)			1,000,000 N	18,800 J	30,500 J	25,200 J	18,400 J	10,500	10,700	12,500	21,600
Antimony (Sb)	31		410 N	1.2 J	5.1 UJ	33.9 J	5.8 UJ	5.5 UJ	5.7 UJ	5.5 UJ	6.0 UJ
Arsenic (As)	23	0.43	1.9 C	24.0 J	13.4 J	104 J	13.4 J	8.8	8.7	8.4 J+	11.8
Barium (Ba)	5,500		72,000 N	231	229	341	204	91.5	101	131	154
Beryllium (Be)	160		2,000 N	0.46 U	0.42 U	0.44 U	0.48 U	0.23 J+	0.025 J+	0.14 J+	0.50 U
Cadmium (Cd)	39		510 N	3.7 J+	6.6	12.3	6.8	1.2 J+	1.2 J+	1.2 J+	1.8 J+
Calcium (Ca)				26,200 J	19,300 J	71,800 J	21,800 J	21,900	20,300	23,100	37,100
Chromium (Cr)	230			26.3	28.6	26.7	29.6	17.8	18.0	19.2	29.0
Cobalt (Co)			20,000 N	8.7	17.6	9.9	10.0	9.2 J	8.9 J	8.8 J	7.8 J
Copper (Cu)			41,000 N	72.6	125	231	103	19.3	19.1	20.9	31.2
Iron (Fe)			310,000 N	23,300 J	27,700 J	39,600 J	23,700 J	21,300	21,000	20,900	21,500
Lead (Pb)			800**	480	408	1,270	474	33.8 J	30.5 J	48.0 J	272 J
Magnesium (Mg)				7,570 J	9,120 J	10,900 J	5,940 J	13,800	13,600	13,000	14,200
Manganese (Mn)	11,000		20,000 N	386	807	254	332	373	352	368	286
Mercury (Hg)	23			0.82	0.10 U	0.82	0.15	0.10 U	0.10 U	0.10 U	0.10 U
Nickel (Ni)	1,600		20,000 N	20.0	18.1	15.4	17.6	19.9	19.6	18.5	17.3
Potassium (K)				4,030	6,060	8,110	4,730	2,550	2,670	2,760	5,540
Selenium (Se)	390		5,100 N	3.2 U	0.83 J+	1.3 J+	3.4 U	3.2 U	3.3 U	3.2 U	1.1 J
Silver (Ag)	390		5,100 N	8.0	1.1 J-	74.7	21.0	0.92 UJ	0.94 UJ	0.91 UJ	1.0 UJ
Sodium (Na)				565	1,930	2,010	107 J	174 J	191 J	375 J-	133 J
Thallium (Tl)			72 N	2.3 UJ	2.1 UJ	2.2 UJ	2.4 UJ	2.3 UJ	2.4 UJ	2.3 U	2.5 U
Vanadium (V)	550		1,000 N	47.8	77.5	51.2	49.2	29.7	28.8	33.8	58.7
Zinc (Zn)	23,000		310,000 N	595	879	1,980	818	89.3 J	83.7 J	84.1 J	174 J
Uranium (U)			200 N	30.5 J	77.9 J	70.7 J	24.1 J	19.8 UJ	19.8 UJ	18.3 UJ	20.0 UJ

J  
U  

RDSC  
SCDM  
N  
\*\*

The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable. J+ indicates possible high bias; J- indicates possible low bias.  
The analyte was not detected at or above the CRDL.  
Lower than Contract Laboratory Program (CLP) standard detection limits.  
The concentration detected is greater than one or more benchmarks.  
Reference Dose Screening Concentration.  
Superfund Chemical Data Matrix.  
Non-carcinogenic effects.  
EPA Lead Sites Workgroup (EPA 2004g).

CRSC  
RBCs  
C

Cancer Risk Screening Concentration.  
Risk-Based Concentrations.  
Carcinogenic effects.

**TABLE 22**  
**Surface Soil Samples Inorganic Analytical Results**  
**Concentrations in milligrams per kilogram (mg/kg (ppm))**  
**(continued)**

Sample ID: Lab Sample ID: Location: Analyte (Abbrev)	SCDM Soil Pathway		RBCs*	VB-BS-M0-01 MH1BH9 Secondary Pond 0-1 inch composite	VB-BP-MS-01 MH1BJ0 Primary Pond 1-18 inch composite	VB-BP-MS-03 MH1BJ4 Primary Pond 1-18 inch composite	VB-SL-30 MH1BJ6 North of Secondary Pond	VB-SL-31 MH1BJ7 North of Secondary Pond	VB-SL-35 MH1BJ8 Area 1 -North of Primary Pond	HMS-11D MH17S0 Xcel Fly Ash 4 - 8 in bgs	VB-BP-02-27B MH1BH7 Blank
	RDSC	CRSC	Industrial Soil								
Aluminum (Al)			1,000,000 N	15,400	9,580	9,360	16,200	13,200	12,900	25,800 J	122
Antimony (Sb)	31		410 N	6.0 UJ	5.9 UJ	5.9 UJ	5.9 UJ	5.9 UJ	2.6 J-	5.7 UJ	6.0 UJ
Arsenic (As)	23	0.43	1.9 C	8.6 J+	9.8 J+	8.7 J+	9.9 J+	5.9 J+	31.2	13.6 J	1.0 U
Barium (Ba)	5,500		72,000 N	173	179	172	232	172	284	1,620	0.26 J
Beryllium (Be)	160		2,000 N	0.50 U	0.069 J+	0.039 J+	0.49 U	0.49 U	0.49 U	0.47 U	0.50 U
Cadmium (Cd)	39		510 N	1.5 J+	2.4 J+	2.2 J+	3.4 J+	1.2 J+	15.1	1.4 J+	0.50 U
Calcium (Ca)				22,100	25,200	24,900	9,310	26,100	22,800	20,600 J	56.5 J
Chromium (Cr)	230			21.6	17.8	17.1	18.5	22.2	16.5	19.2	1.0 U
Cobalt (Co)			20,000 N	8.6 J	9.0 J	8.6 J	11.4 J	9.6 J	9.8 J	6.3	5.0 UJ
Copper (Cu)			41,000 N	29.5	34.7	33.6	65.9	23.5	247	35.4	2.5 U
Iron (Fe)			310,000 N	21,700	21,800	21,900	23,800	18,800	42,400	14,000 J	54.4
Lead (Pb)			800**	170 J	259 J	262 J	822 J	86.9 J	3,260 J	18.8	0.40 J
Magnesium (Mg)				8,900	9,970	10,500	5,820	6,350	4,390	3,410 J	23.7 J
Manganese (Mn)	11,000		20,000 N	421	595	590	474	306	307	123	3.8
Mercury (Hg)	23			0.10 U	0.10 U	0.10 U	0.10 U	0.10 U	0.56	0.10 UJ	0.10 U
Nickel (Ni)	1,600		20,000 N	19.6	17.0	15.7	13.4	17.4	10.8	14.0	0.23 J
Potassium (K)				3,660	2,260	2,290	3,510	3,440	4,710	1,200	500 U
Selenium (Se)	390		5,100 N	3.5 U	3.4 U	3.5 U	3.4 U	3.5 U	2.3 J+	2.3 J+	3.5 U
Silver (Ag)	390		5,100 N	1.0 UJ	2.0	2.3	0.98 UJ	0.99 UJ	1.9	0.94 U	1.0 U
Sodium (Na)				108 J	215 J	219 J	605	166 J	438 J-	2,020	95.7 J-
Thallium (Tl)			72 N	2.5 U	2.5 U	2.5 U	2.5 UJ	2.5 UJ	2.5 UJ	2.4 UJ	2.5 U
Vanadium (V)	550		1,000 N	39.1	28.7	27.3	47.3	36.8	46.4	62.8	0.23 J
Zinc (Zn)	23,000		310,000 N	137 J	319 J	293 J	375 J	91.9 J	2,160 J	39.6	6.0 UJ
Uranium (U)			200 N	22.1 UJ	26.1 UJ	27.6 UJ	38.1 J	24.5 J	84.5 J	18.9 UJ	20.0 UJ

J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable. J+ indicates possible high bias; J- indicates possible low bias.

U The analyte was not detected at or above the CRDL.

[ ] The associated numerical value was detected below the CRDL, but greater than the method detection limit and is therefore an estimate (qualified by laboratory)

( ) Sample Quantitation Limit (SQL).

 Lower than Contract Laboratory Program (CLP) standard detection limits.

The concentration detected is greater than one or more benchmarks.

RDSC	Reference Dose Screening Concentration.	CRSC	Cancer Risk Screening Concentration.
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RBCs Risk-Based Concentrations.

N	Non-carcinogenic effects.	C	Carcinogenic effects.
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9
10	10	10	10
11	11	11	11
12	12	12	12
13	13	13	13
14	14	14	14
15	15	15	15
16	16	16	16
17	17	17	17
18	18	18	18
19	19	19	19
20	20	20	20
21	21	21	21
22	22	22	22
23	23	23	23
24	24	24	24
25	25	25	25
26	26	26	26
27	27	27	27
28	28	28	28
29	29	29	29
30	30	30	30
31	31	31	31
32	32	32	32
33	33	33	33
34	34	34	34
35	35	35	35
36	36	36	36
37	37	37	37
38	38	38	38
39	39	39	39
40	40	40	40
41	41	41	41
42	42	42	42
43	43	43	43
44	44	44	44
45	45	45	45
46	46	46	46
47	47	47	47
48	48	48	48
49	49	49	49
50	50	50	50
51	51	51	51
52	52	52	52
53	53	53	53
54	54	54	54
55	55	55	55
56	56	56	56
57	57	57	57
58	58	58	58
59	59	59	59
60	60	60	60
61	61	61	61
62	62	62	62
63	63	63	63
64	64	64	64
65	65	65	65
66	66	66	66
67	67	67	67
68	68	68	68
69	69	69	69
70	70	70	70
71	71	71	71
72	72	72	72
73	73	73	73
74	74	74	74
75	75	75	75
76	76	76	76
77	77	77	77
78	78	78	78
79	79	79	79
80	80	80	80
81	81	81	81
82	82	82	82
83	83	83	83
84	84	84	84
85	85	85	85
86	86	86	86
87	87	87	87
88	88	88	88
89	89	89	89
90	90	90	90
91	91	91	91
92	92	92	92
93	93	93	93
94	94	94	94
95	95	95	95
96	96	96	96
97	97	97	97
98	98	98	98
99	99	99	99
100	100	100	100

\*\* EPA Lead Sites Workgroup (EPA 2004g).

TDD No. 0405-0006

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TABLE 23  
Subsurface Soil Samples Inorganic Analytical Results  
Concentrations in milligrams per kilogram (mg/kg (ppm))

Sample ID: Lab Sample ID: Location: Analyte      (Abbrev)	SCDM Soil Pathway		EPA Region 3 RBCs (04/2004)	VB-BP-07-14 MH1BG2 Bore 7 Primary Pond 14 ft bgs	VB-BP-05-09 MH1BG3 Bore 5 Primary Pond 9-9.5 ft bgs	VB--BP-05-35 MH1BG4 Bore 5 Primary Pond 35 ft bgs	VB-BD-03-04 MH1BG5 Bore 3 Disposal Pit 4.5-5 ft bgs	VB-BS-32-05 MH1BG6 Bore 32 Secondary Pond 5-5.5 ft bgs	VB-BS-33-08 MH1BG7 Bore 33 Secondary Pond 8-8.5 ft bgs	VB-BS-38-05 MH1BG8 Bore 38 Secondary Pond 5-5.5 ft bgs	VB-BS-38-10 MH1BG9 Bore 38 Secondary Pond 10-10.5 ft bgs
	RDSC	CRSC	Industrial Soil								
Aluminum      (Al)			1,000,000 N	6,190 J	3,920 J	6,420 J	15,500 J	21,000 J	11,500 J	11,700 J	10,400 J
Antimony      (Sb)	31		410 N	2.0 J	35.9 J	5.5 UJ	0.81 J	5.5 UJ	5.8 UJ	5.6 UJ	5.2 UJ
Arsenic      (As)	23	0.43	1.9 C	27.9 J	106 J	28.5 J	34.0 J	6.5 J+	5.6 J+	9.2 J	9.3 J
Barium      (Ba)	5,500		72,000 N	704	22.3	209	235	290	117	125	261
Beryllium      (Be)	160		2,000 N	0.40 J	0.24 J	0.33 J	0.48 U	0.46 U	0.48 U	0.29 J	0.43 J
Cadmium      (Cd)	39		510 N	10.3	80.4	8.5	5.7	1.2 J+	0.94 J+	1.1 J+	1.2 J+
Calcium      (Ca)				23,400 J	21,300 J	24,600 J	21,400 J	94,800 J	24,700 J	62,300 J	42,200 J
Chromium      (Cr)	230			6.7	5.2	5.4	30.0	27.0	18.8	17.0	16.5
Cobalt      (Co)			20,000 N	4.8 U	25.8	6.7	6.9	10.0	8.1	6.0	7.0
Copper      (Cu)			41,000 N	723	1,070	308	157	22.4	18.4	14.6	16.9
Iron      (Fe)			310,000 N	27,200 J	129,000 J	34,200 J	45,800 J	21,800 J	17,900 J	18,500 J	22,400 J
Lead      (Pb)			800**	3,230	30,000	1,430	2,020	10.9	16.9	13.0	14.3
Magnesium      (Mg)				3,040 J	920 J	2,030 J	9,090 J	10,400 J	10,100 J	14,900 J	14,900 J
Manganese      (Mn)	11,000		20,000 N	421	1,260	453	251	297	281	287	295
Mercury      (Hg)	23			0.14	1.4	0.14	0.27	0.10 U	0.095 U	0.10 U	0.10 U
Nickel      (Ni)	1,600		20,000 N	5.7	15.7	5.2	14.3	20.3	17.1	16.2	18.5
Potassium      (K)				5,110	3,030	4,450	4,580	3,660	2,810	2,080	2,050
Selenium      (Se)	390		5,100 N	2.4 J+	27.3	2.0 J+	1.5 J+	0.64 J+	3.4 U	0.86 J	3.0 U
Silver      (Ag)	390		5,100 N	5.9	68.4	2.4	0.96 UJ	0.92 UJ	0.96 UJ	0.93 UJ	0.87 UJ
Sodium      (Na)				631	98.7 J	492	916	492	501	185 J	438
Thallium      (Tl)			72 N	2.4 UJ	1.1 J-	2.3 UJ	2.4 UJ	2.3 UJ	2.4 UJ	2.3 UJ	2.2 UJ
Vanadium      (V)	550		1,000 N	39.8	21.1	32.6	62.0	56.2	29.0	28.3	23.3
Zinc      (Zn)	23,000		310,000 N	1,850	12,700	1,310	740	57.8	59.6	58.8	69.8
Uranium      (U)			200 N	122 J	428 J	93.3 J	59.3 J	28.8 J	22.8 UJ	20.8 UJ	24.4 UJ

J

U

N

The associated numerical value is an estimated quantity because quality control criteria were not met.

The analyte was not detected at or above the CRDL.

Lower than Contract Laboratory Program (CLP) standard detection limits.

The concentration detected is greater than one or more benchmarks.

Non-carcinogenic effects.

ft bgs

RDSC

SCDM

feet below ground surface

Reference Dose Screening Concentration.

Superfund Chemical Data Matrix.

Presence of the element is reliable.

J+ indicates possible high bias; J- indicates possible low bias.

\*\*

EPA Lead Sites Workgroup (EPA 2004g).

CRSC

Cancer Risk Screening Concentration.

RBCs

Risk-Based Concentrations.

Sources: EPA 2004b (SCDM); EPA 2004a (Region 3 RBCs)

TABLE 23  
Subsurface Soil Samples Inorganic Analytical Results  
Concentrations in milligrams per kilogram (mg/kg (ppm))  
(continued)

Sample ID: Lab Sample ID: Location: Analyte (Abbrev)	SCDM Soil Pathway		EPA Region 3 RBCs (04/2004)	VB-BD-MD-02 MH1BH3 Disposal Pit 2 ft to depth - composite	VB-BP-30-25D MH1BH8 Bore 30 Primary Pond 25.5-27 ft bgs	VB-BP-MD-01 MH1BJ1 Primary Pond 2 ft to depth composite	VB-DP-01-09 MH1BJ2 Primary Pond Dam 26-27 ft bgs	VB-DP-01-26 MH1BJ3 Primary Pond Dam 26-27 ft bgs	VB-DP-MD-01 MH1BJ5 Primary Pond Dam 2 ft-depth composite	VB-BP-02-27B MH1BH7 Blank
	RDSC	CRSC	Industrial Soil							
Aluminum (Al)			1,000,000 N	12,000	12,500	8,330	10,100	11,000	10,900	122
Antimony (Sb)	31		410 N	5.8 UJ	6.0 UJ	2.8 J-	3.3 J-	5.7 UJ	4.2 J-	6.0 UJ
Arsenic (As)	23	0.43	1.9 C	7.9 J+	8.6 J+	35.0	29.5	5.2 J+	51.8	1.0 U
Barium (Ba)	5,500		72,000 N	122	79.1	516	279	127	287	0.26 J
Beryllium (Be)	160		2,000 N	0.32 J	0.37 J	0.20 J+	0.11 J+	0.16 J+	0.47 U	0.50 U
Cadmium (Cd)	39		510 N	1.8 J+	1.0 J+	14.0	25.9	1.1 J+	27.3	0.50 U
Calcium (Ca)				28,200	21,200	25,700	65,300	85,300	29,000	56.5 J
Chromium (Cr)	230			18.4	19.2	9.8	2.1	15.3	12.4	1.0 U
Cobalt (Co)			20,000 N	8.5 J	9.5 J	6.9 J	5.0 UJ	6.7 J	11.0 J	5.0 UJ
Copper (Cu)			41,000 N	18.6	19.1	297	129	15.8	368	2.5 U
Iron (Fe)			310,000 N	21,000	20,500	29,100	9,120	15,500	47,700	54.4
Lead (Pb)			800*	23.3 J	19.8 J	3,390 J	6,550 J	147 J	5,100 J	0.40 J
Magnesium (Mg)				13,800	15,100	2,790	1,170	14,700	5,040	23.7 J
Manganese (Mn)	11,000		20,000 N	367	257	483	89.0	309	426	3.8
Mercury (Hg)	23			0.10 U	0.10 U	0.37	3.0	0.10 U	0.95	0.10 U
Nickel (Ni)	1,600		20,000 N	18.3	22.3	7.1	1.0 J	13.9	10.9	0.23 J
Potassium (K)				2,550	2,380	4,760	10,200	1,420	4,310	500 U
Selenium (Se)	390		5,100 N	3.4 U	3.5 U	2.3 J	1.8 J+	1.3 J+	3.3 J+	3.5 U
Silver (Ag)	390		5,100 N	0.97 UJ	1.0 UJ	5.1	4.8	0.94 UJ	5.0	1.0 U
Sodium (Na)				404 J-	423 J-	490 J-	738	282 J	546	95.7 J-
Thallium (Tl)			72 N	2.4 U	2.5 U	2.5 U	2.5 U	2.4 U	2.4 UJ	2.5 U
Vanadium (V)	550		1,000 N	30.1	30.4	33.9	14.7	31.2	34.6	0.23 J
Zinc (Zn)	23,000		310,000 N	115 J	81.9 J	1,970 J	3,110 J	94.2 J	3,870 J	6.0 UJ
Uranium (U)			200 N	21.6 UJ	20.4 UJ	89.6 J	35.6 UJ	29.6 UJ	132 J	20.0 UJ

J The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable. J+ indicates possible high bias; J- indicates possible low bias.  
U The analyte was not detected at or above the CRDL.  
[ ] The associated numerical value was detected below the CRDL, but greater than the method detection limit and is therefore an estimate (qualified by laboratory).  
( ) Sample Quantitation Limit (SQL).  
Lower than Contract Laboratory Program (CLP) standard detection limits.  
The concentration detected is greater than one or more benchmarks.  
RDSC Reference Dose Screening Concentration. CRSC Cancer Risk Screening Concentration. SCDM Superfund Chemical Data Matrix. RBCs Risk-Based Concentrations.  
N Non-carcinogenic effects. C Carcinogenic effects. \*\* EPA Lead Sites Workgroup (EPA 2004g).

Sources: EPA 2004b (SCDM); EPA 2004a (Region 3 RBCs).

**TABLE 24**  
**Field XRF and Laboratory Lead Analytical Data Collaborative Results**  
**(Concentrations in milligrams per kilogram (mg/kg) (ppm))**

Sample ID	XRF - Lead	Lab - Lead
HMS-11D	53 J	18.8
VB-BD-03-04	2,200	2,020
VB-BD-MD-02	31 J	23.3 J
VB-BD-MO-01	19*	33.8 J
VB-BD-MO-03	20 J	30.5 J
VB-BD-MS-02	47 J	48 J
VB-BP-02-27B	17 U	0.4 J
VB-BP-05-09	14,000	30,000
VB-BP-05-35	1,000	1,430
VB-BP-07-14	2,900	3,230
VB-BP-30-25D	44 J	19.8 J
VB-BP-MD-01	2,500	3,390 J
VB-BP-MS-01	310	259 J
VB-BP-MS-03	64	262 J
VB-BS-32-05	33 J	10.9
VB-BS-33-08	23 J	16.9
VB-BS-38-05	13*	13
VB-BS-38-10	18 J	14.3
VB-BS-MO-01	240	170 J
VB-DP-01-09	6,200	6,550 J
VB-DP-01-26	130	147 J
VB-DP-MD-01	3,000	5,100 J
VB-SG-03	500	407
VB-SG-04	400	320
VB-SG-27	340	297
VB-SL-01	500	474
VB-SL-10	1,300	1,270
VB-SL-20	74	48.6 J
VB-SL-23	300	272 J
VB-SL-30	1,000	822 J
VB-SL-31	110	86.9 J
VB-SL-35	3,400	3,260 J
VB-SU-04	90	53.5
VB-SU-05	80	48.2
VB-SU-08	200	171
VB-SU-10	110	77.2
VB-SU-12D	530	480
VB-SU-13	460	408

XRF X-Ray Fluorescence

U The associated numerical value is an estimated quantity because quality control criteria were not met. Presence of the element is reliable.

U The substance was not detected at or above the reported concentration.

\* VB-BD-MO-01 results of 1,800 and VB-BS-38-05 results of 2,100 initially reported are in error

**TABLE 25**  
**Xcel Energy Unit 5 Fly Ash**  
**1998 Inorganic Analytical Results**  
**(Concentrations in ppm)**

Analyte	Total Metals	TCLP	TCLP Limit
Silver	89	0.5 U	5.0
Arsenic	221	0.5 U	5.0
Barium	2,600	0.5	100.0
Beryllium	ND	0.5 U	NL
Cadmium	1	0.5 U	1.0
Chromium	231	0.7	5.0
Mercury	0.17	0.0005 U	0.2
Nickel	113	0.5 U	NL
Lead	ND	0.5 U	5.0
Antimony	ND	0.5 U	NL
Selenium	ND	0.5 U	1.0
Bromide	168	NA	NL
Chloride	1,700	NA	NL
Copper	90	0.5 U	NL
Fluoride	277	NA	NL
Manganese	ND	0.5 U	NL
Cobalt	17	0.5 U	NL
Thallium	ND	0.5 U	NL
Zinc	44	0.5 U	NL

NA Not analyzed  
 NL TCLP limit not established

Sources: Xcel Energy 1998; Xcel Energy 2004.